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NIOBRARA RIVER BASIN (INCLUDING PONCA CREEK VALLEY) WATER POLLUTION INVESTIGATION

Public Health Service
Kansas City, Missouri

September 1950

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NIOBRARA RIVER BASIN
WATER POLLUTION INVESTIGATION

#15

MONTANA
N. DAK
S. DAK
WYOMING
NIOBRARA
IOWA
NEBRASKA
Platte
COLO
KANSAS
MISSOURI

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE

JANUARY 1951

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Niobrara River Basin (including Ponca Creek valley) water pollution investigation. Sept.1950.(Division of Water Pollution Control, Missouri Drainage Basin, Kansas City, Mo.)[Prepared in cooperation with Bureau of Reclamation, Region 7, and Water Pollution Control agencies of Nebraska, South Dakota and Wyoming. No LC copy 11/71

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Federal Security Agency
Public Health Service
Division of Water Pollution Control
Missouri Drainage Basin
Kansas City, Missouri

September 1950

NIOBRARA RIVER BASIN (INCLUDING PONCA CREEK VALLEY) WATER POLLUTION INVESTIGATION

Prepared by the Public Health Service at request of and in cooperation with the Bureau of Reclamation, Region 7, and the Water Pollution Control Agencies of the States of Nebraska, South Dakota, and Wyoming

I

NIOBRARA RIVER BASIN (INCLUDING PONCA CREEK VALLEY) WATER POLLUTION INVESTIGATION

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INTRODUCTION

The land and water resources development program of the Missouri River Basin contemplates the utilization of its water resources for maximum benefit to the nation. Basic planning for water resources development must include studies of water supply and sanitation needs, including present water quality, water usage, and the sources and amounts of pollution contributed to streams.

The Bureau of Reclamation, Department of Interior, now engaged in the formulation of comprehensive plans for development of water resources, believed it necessary that basin-wide studies of stream pollution be conducted to establish base data for use in planning maximum water utilization; to document the extent and nature of existing pollution; and to record general standards of water quality. Early in 1949, arrangements were completed between Region No. 7, Bureau of Reclamation, the U. S. Public Health Service, and the Nebraska State Health Department whereby a comprehensive water pollution investigation of the Lower Platte River Basin would be made by the Public Health Service and the Nebraska State Health Department. This is covered in a Memorandum of Understanding respecting a joint program for stream pollution investigations of the Lower Platte River Basin[1], entered into on March 29, 1949 by Region 7, Bureau of Reclamation, and the Missouri Drainage Basin Office, Public Health Service.

The need for such a study in the Niobrara River area was apparent to the Bureau of Reclamation although no means were available to carry out such a survey. At the request of the Bureau of Reclamation, it was agreed by the Public Health Service that the Lower Platte River Basin Water Pollution Investigation would be extended to include the region covered by the Niobrara River Area Office of the Bureau of Reclamation.

Sanitary engineers detailed to the Lower Platte River Basin Study by the Nebraska State Health Department and the Public Health Service included the Niobrara River Basin and Ponca Creek Valley in their investigations. A mobile laboratory unit was moved to Ainsworth, Nebraska, in the Niobrara River Basin, June 8, 1949. The collection of stream samples and laboratory analyses began two days later, and continued until June 29. Laboratory units located in the Lower Platte River Basin supplemented the latter activity.

The report of water pollution in the Niobrara River Area as represented by this document, has been prepared in cooperation with the respective State Water Pollution Control Agencies of Nebraska, Wyoming, and South Dakota, and the Bureau of Reclamation.

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[1] Report of Lower Platte River Basin Water Pollution Investigation - June 1950.

The body of the report contains background information, reviews of State water pollution control laws, laboratory results, presentation of data, discussion, conclusions and recommendations. An appendix is included for individual laboratory and flow data and other pertinent information.

ACKNOWLEDGMENT

Special acknowledgment is made of the support and cooperation, including personnel and funds, given this investigation by the Nebraska Water Pollution Control Agency represented by Dr. W. S. Petty, State Health Officer; T. A. Filipi, Director, Division of Sanitation, and R. M. Babcock, Public Health Engineer. Over 80 percent of the area studied was within the State of Nebraska.

The Wyoming Water Pollution Control Agency represented by Dr. F. D. Yoder, State Health Officer, and L. O. Williams, Director of Public Health Engineering, and South Dakota Water Pollution Control Committee represented by Dr. G. J. Van Heuvelen, State Health Officer and C. E. Carl, Director, Division of Sanitary Engineering, supplied supplemental information and a critical review of this report.

The assistance rendered by Regional Director Avery A. Batson, Region 7, Bureau of Reclamation, and members of his staff in supporting these investigations, has been outstanding. The Niobrara River Area Office, Bureau of Reclamation, through Area Engineer Clyde E. Burdick and Hydrologist Kenneth B. Schroeder, provided much essential information. Stream discharge data were obtained from District Engineer Douglas D. Lewis of the District Office, U. S. Geological Survey, at Lincoln, Nebraska, and Dan S. Jones, State Engineer of the Nebraska State Bureau of Irrigation, Water Power and Drainage. Studies of the Fish and Wildlife Service were used in the preparation of the report. Technical reviews of this report by the Environmental Health Center, Cincinnati, Ohio, and the Division of Water Pollution Control, Washington, D. C., have been most helpful. This report was prepared in close collaboration with the Water Pollution Control Agencies of Nebraska, South Dakota and Wyoming who have reviewed the report and have given their approval of the contents.

This opportunity is taken to gratefully acknowledge the help and excellent cooperation shown by all connected with the Niobrara River Basin Water Pollution Investigation.

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SUMMARY

This report presents the water pollution investigation of the Niobrara River Basin and Ponca Creek Valley.

The Niobrara River rises in eastern Wyoming and flows eastward 431 miles to its confluence with the Missouri River. Ponca Creek has its source in southeastern South Dakota and flows through a narrow valley to the Missouri River.

The economy of the region is based upon agriculture and related industries with livestock raising providing the greatest source of income. Irrigation has been instrumental in increasing the cash income from the production of grain, forage and root crops. Existing irrigation systems augmented by additional irrigation works planned by the Bureau of Reclamation indicate that a substantial increase in the production of such crops may be anticipated.

Nine major reservoirs and two major diversionary structures have been proposed for the Basin to conserve water for irrigation, hydroelectric power and other uses. The existing Mirage Flats project, including a storage reservoir and a major diversion unit, is part of the over-all development plan.

One municipality serves a population of 500 with a public water supply obtained from surface sources while the remaining 26 communities serving 15,350 people tap a generally adequate underground aquifer. Shortages in Ponca Creek Valley and at Hay Springs, Nebraska, indicate that in the future, further recourse to surface sources may become necessary. The development program may provide water supply benefits.

A sparse population produces light to moderate pollution. Ten municipalities contribute domestic and industrial wastes to surface streams. The total amount of wastes produced is equivalent to 12,420 persons of which industry contributes 22 percent. Sewage treatment works at 7 communities reduce the pollution load discharged to streams 44 percent to 6,985 population equivalents. A minimum of primary sewage treatment for all wastes should be provided; a higher degree of treatment should be installed where needed. New treatment plants or improvements are required at 10 municipalities.

A suggested program for State action toward a comprehensive program of water pollution control including adequate State law and recommendations for sufficient personnel is presented.

Flow routing and regulation as proposed by the Bureau of Reclamation will affect stream discharges. Minimum desirable stream flows for public health purposes at pertinent locations have been specified and should be met by the development program when possible.

CONCLUSIONS

1. The development program of the Bureau of Reclamation for maximum beneficial use of water resources in the Niobrara River Area will have an influence, in some cases, upon those matters such as public water supply, public health and sanitation which are dependent upon adequate sustained stream flows. Ten major impoundments and three diversion structures, including the existing Box Butte Reservoir and Dunlap Diversion Dam, are included in the plan in addition to numerous pumping units and other improvements.

2. One municipality with a population of 500 uses a surface source for its public water supply. However, ground water shortages in Ponca Creek Valley and at Hay Springs, Nebraska, indicate that in the future, recourse to surface sources at these places may be necessary. Water from the development program may benefit these users.

3. Twenty-six municipalities obtain water supplies from ground sources and serve a total population of 15,350 with an average of 3.03 million gallons daily. Except for Ponca Creek Valley and one place in the Niobrara Basin, supplies are generally adequate and the quality good.

4. The pollution load is light to moderate and minimized by the fact that sources of pollution generally discharge to tributary streams and are separated by considerable distances. Sewage from a population of 9,665 and industrial wastes with a sewered population equivalent of 2,755 for a total sewered population equivalent of 12,420 is produced. Existing treatment works at 7 communities reduce pollution load 44 percent to 6,985 population equivalents.

5. New sewage treatment plants or improvements are needed at 10 municipalities. These needs are specified in table 12.

6. State water pollution control activities have been commensurate with water use, financial support and legal backing. An active basin-wide program for the control and abatement of pollution with adequate funds and supporting legislation is indicated.

7. Stream flows compatible with a minimum of primary treatment and a balanced aquatic life in streams is a desirable objective of the development program. Wherever possible, stream regulation should consider provisions for these minimum flows.

8. As exemplified by cooperative efforts of the Bureau of Reclamation, the Public Health Service and the State Health Departments in the preparation of this report, consideration of public health and sanitation needs properly fits into the planning stages of the development program.

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RECOMMENDATIONS

It is recommended that:

1. The States of Nebraska, South Dakota, and Wyoming provide adequate statutory support for the control of water pollution.

2. The State governments of Nebraska, South Dakota, and Wyoming more energetically support water pollution control programs by providing sufficient funds to permit procurement of adequate staffs of sanitary engineers by State Water Pollution Control Agencies in order to develop a comprehensive pollution control and abatement program that will assure complete coverage throughout the States, and afford assistance and consultation to communities and industries.

3. Sewage treatment be provided at Verdigre, Valentine, and Spencer, Nebraska.

4. A higher degree of sewage treatment be provided at Lusk, Wyoming, and Gregory, South Dakota; and expansion of present treatment facilities at Gordon, Rushville and Hay Springs, Nebraska be effected.

5. Verdigre, Nebraska provide more effective water treatment to insure a safe supply.

6. Caution be exercised in the use of sewage-polluted irrigation waters, particularly in the case of low-growing crops which may be consumed raw. Chlorination of sewage treatment plant effluents to control pathogenic organisms may be required.

7. Flow regulation as related to the development program provide, where possible, the desirable minimum flows specified in table 13 of this report.

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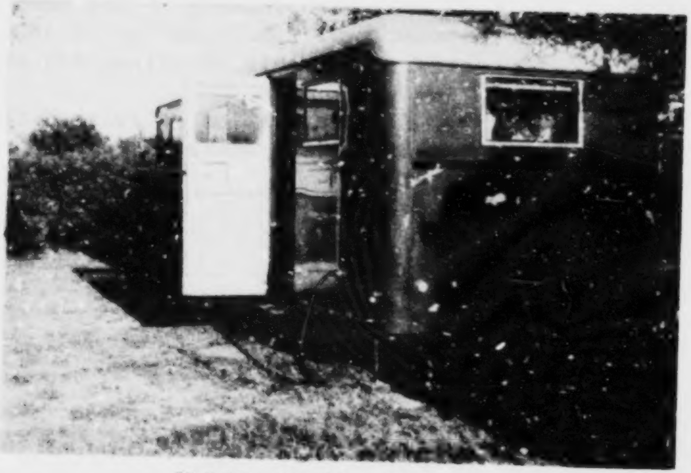
Niobrara River
Below Wyoming-Nebraska State Line

Niobrara River
Above Meadville, Nebraska



Mobile Trailer Laboratory

HISTORICAL BACKGROUND

The Niobrara River Basin lies in the Great Plains Region of the Central States. Large herds of buffalo roamed the plains and supported the Indian population inhabiting the region prior to the influx of white people. The Indians described the river by the term "Niobrara", meaning "Running Water" or "broad or large water". The name, which has been retained to the present day, is apparently descriptive of the constant flow characteristics. Ponca Creek was named after the Ponca Indians.

The first white settlers inhabited the lower reaches of the area about 1860 and populated the upper sections about 1885. Development of the Basin expanded with the construction of the Northwestern Railroad (now the Chicago and Northwestern) in the latter part of the nineteenth century. Cattle raising was the basis of the early economy, and agriculture was practiced upon hard land areas. Good farming years, experienced during the '70s and '80s were followed by a severe drought in the middle '90s causing numerous settlers to leave. Those remaining, who had farms located near streams where simple irrigation systems could be constructed, turned to irrigation to insure continued production of crops.

PHYSICAL DESCRIPTION

Geography

The Niobrara River Area Office of the Bureau of Reclamation has under its purview that area encompassed by the Niobrara River Basin and Ponca Creek Valley (figure 1). The Niobrara River Basin is relatively long and narrow and contains about 13,000 square miles. The Wyoming portion comprises 590 square miles; the South Dakota portion, including a part of Ponca Creek Valley, totals approximately 1,735 square miles; and the remainder lies in Nebraska. The Niobrara River drains a small section of the counties of Niobrara and Goshen in Wyoming, in addition to most of the northernmost counties in Nebraska. The Keya Paha River, which is the principal tributary of the Niobrara, drains parts of Todd and Tripp Counties in South Dakota besides portions of Keya Paha and Boyd Counties in Nebraska.

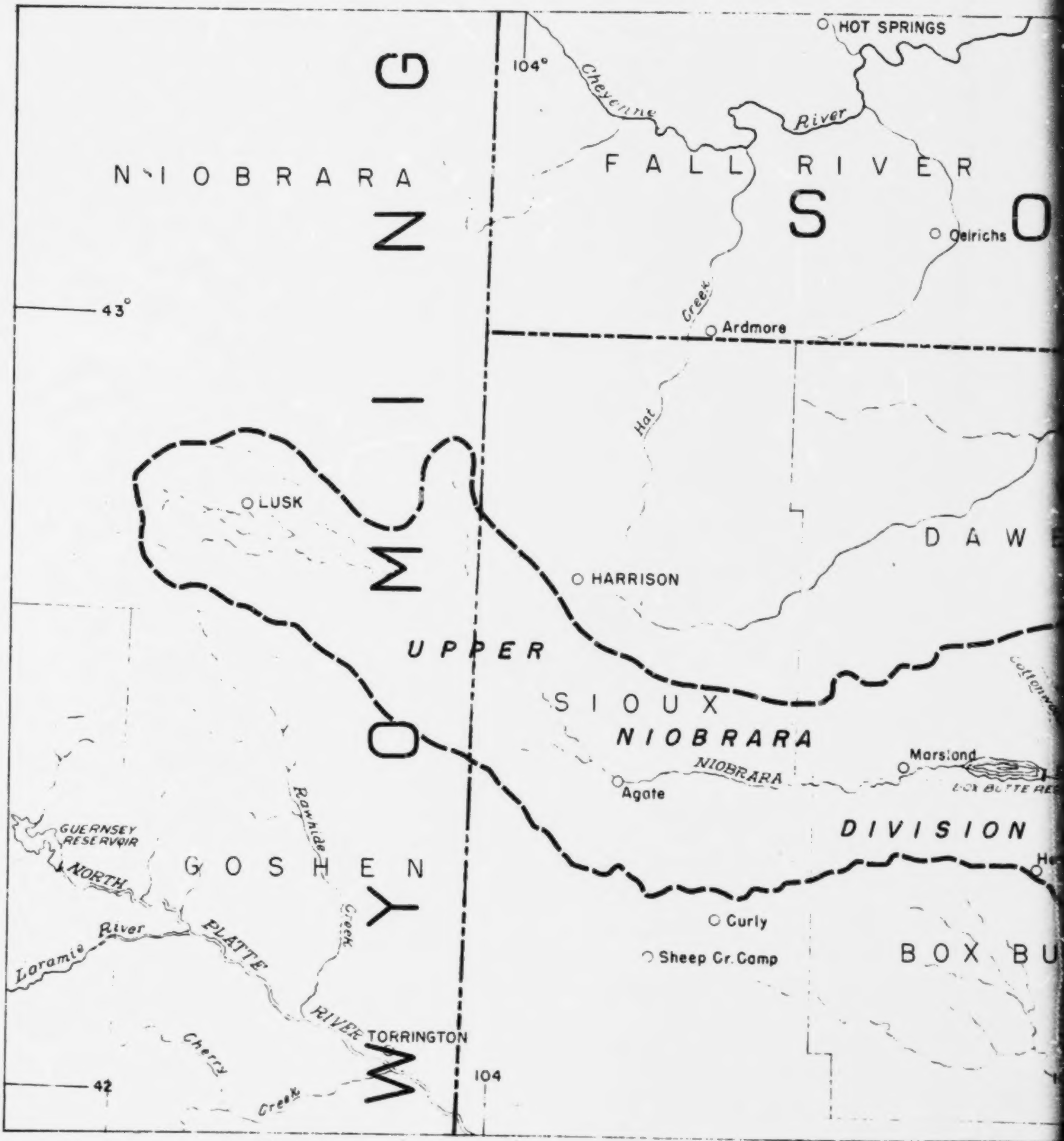
Ponca Creek is a minor tributary of the Missouri River and drains an area of 827 square miles located in Nebraska and South Dakota. The Valley is long and narrow, being about 90 miles in length and 10 miles in width. Sixty percent of the watershed is in South Dakota and the remainder is in Nebraska.

Principal streams of the area are presented in table 1.

Table 1. Principal streams

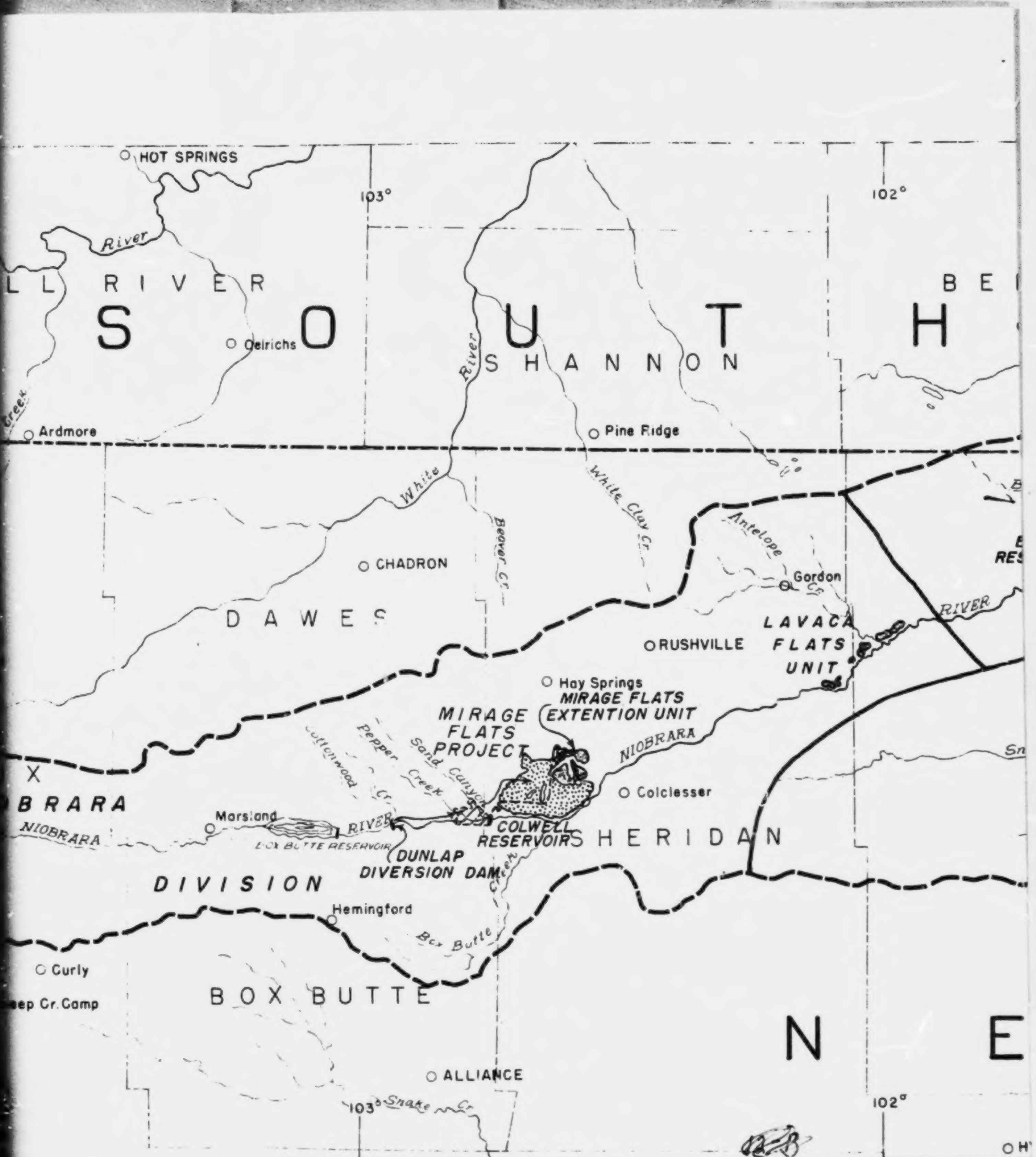
Stream	Miles above mouth Niobrara River	Drainage area square miles
Niobrara River		13,000
Verdigre Creek	5	614
Keya Paha River	60	1,832
Long Pine Creek	96	263
Plum Creek	109	727
Minnechaduza Creek	146	447
Gordon Creek	160	a
Snake River	169	1,599
Bear Creek	204	422
Ponca Creek		827

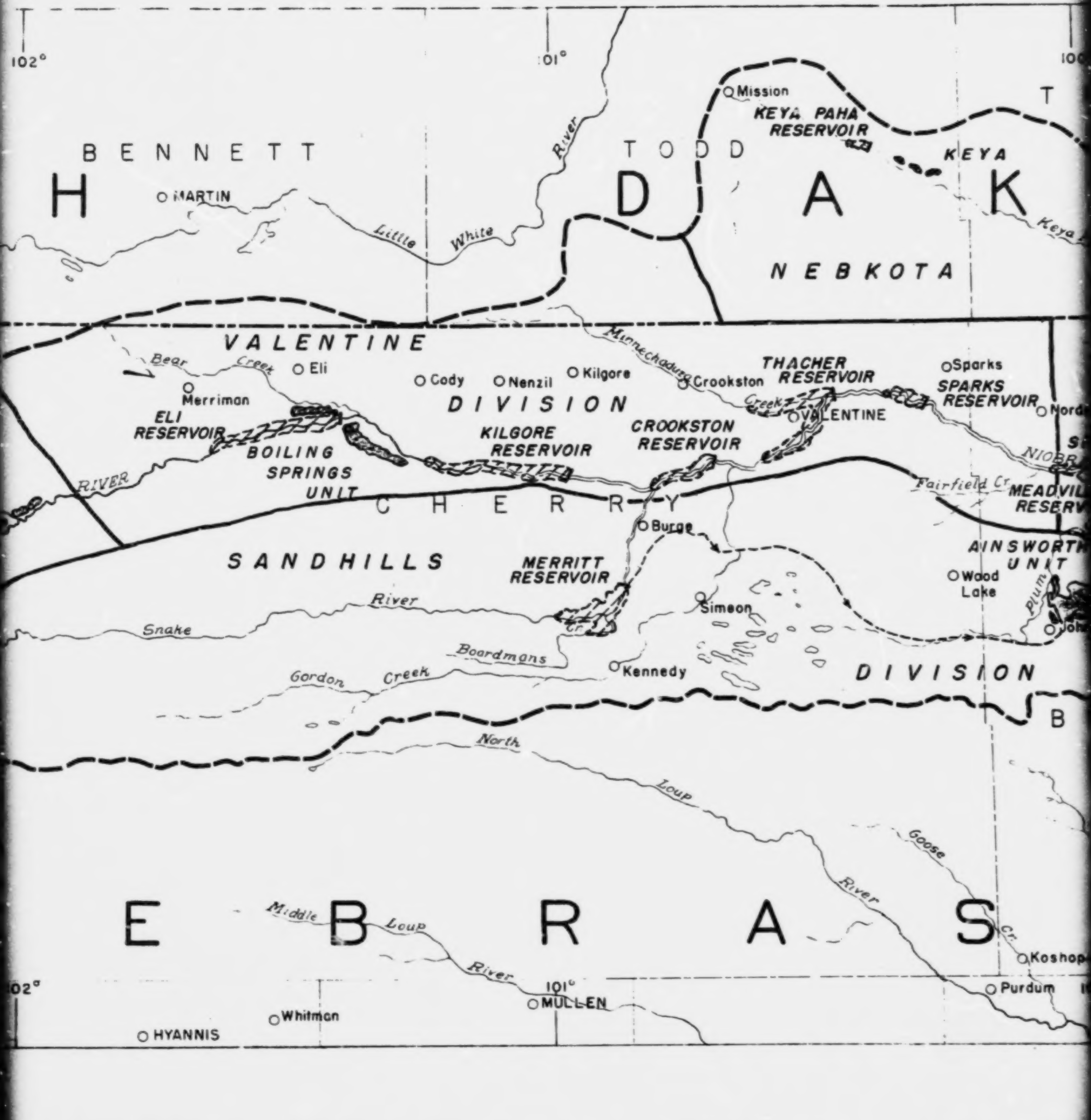
a. Data not available



HOT SPRINGS
104°
Cheyenne River
FALL RIVER
S O
Oelrichs
NIOBRARA
43°
Ardmore
Creek
Hat
WYOMING
LUSK
HARRISON
DAW
UPPER
SIOUX
NIOBRARA
Cottonw
Marsland
NIOBRARA
Agate
BOX BUTTE RE
DIVISION
He
GUERNSEY RESERVOIR
NORTH
GOSHEN
Rawhide
Creek
Laramie River
PLATTE
RIVER
TORRINGTON
Curly
Sheep Cr. Camp
BOX BU
Cherry
Creek
42
104

12L


HOT SPRINGS
River
103°
102°
RIVER
BE
S O U T H
SHANNON
Oelrichs
Creek
River
Ardmore
Pine Ridge
White
White Clay Cr.
Beaver Cr.
Antelope
CHADRON
Gordon
Cr.
DAWES
LAVACA FLATS UNIT
RUSHVILLE
RIVER
RES
Hay Springs
MIRAGE FLATS EXTENTION UNIT
MIRAGE FLATS PROJECT
Cottonwood
Pepper Cr.
Sand Canyon
Creek
NIOBRARA
X
BRARA
Colclesser
Marsland
NIOBRARA
RIVER
BOX BUTTE RESERVOIR
COLWELL RESERVOIR
SHERIDAN
DUNLAP DIVERSION DAM
Creek
DIVISION
Hemingford
Box Butte
Curly
ep Cr. Camp
BOX BUTTE
N E
ALLIANCE
103°
Snake Cr.
102°
Sn
HY


102°
101°
100
T
BENNETT
TODD
H
D
A
K
MARTIN
Mission
KEYA PAHA RESERVOIR
KEYA
Keya
NEBKOTA
Little White River
VALENTINE DIVISION
Bear Creek
Eli
Merriman
Cody
Nenzil
Kilgore
Minnechaduza Creek
Crookston
THACHER RESERVOIR
Sparks
SPARKS RESERVOIR
VALENTINE
ELI RESERVOIR
BOILING SPRINGS UNIT
KILGORE RESERVOIR
CROOKSTON RESERVOIR
RIVER
NIOBR
Fairfield Cr.
MEADVIL
RESERV
CHERRY
Burge
SANDHILLS DIVISION
MERRITT RESERVOIR
AINSWORTH UNIT
Wood Lake
Plum
Snake River
Cr.
Simeon
Boardmans
Gordon Creek
Kennedy
B
North Loup River
Goose Cr.
E
B
R
A
S
Middle Loup River
Koshop
Purdum
102°
101°
MULLEN
Whitman
HYANNIS

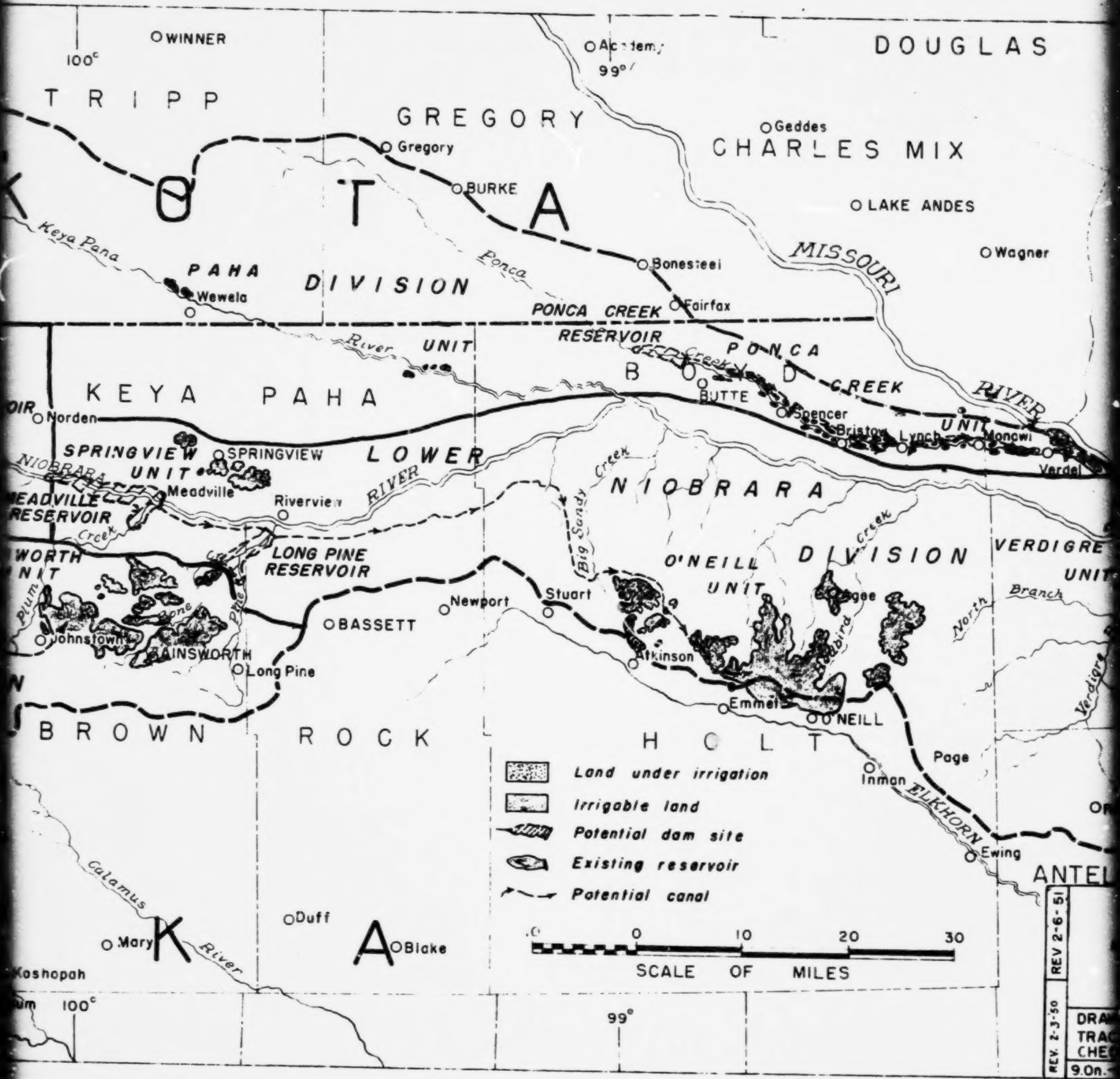
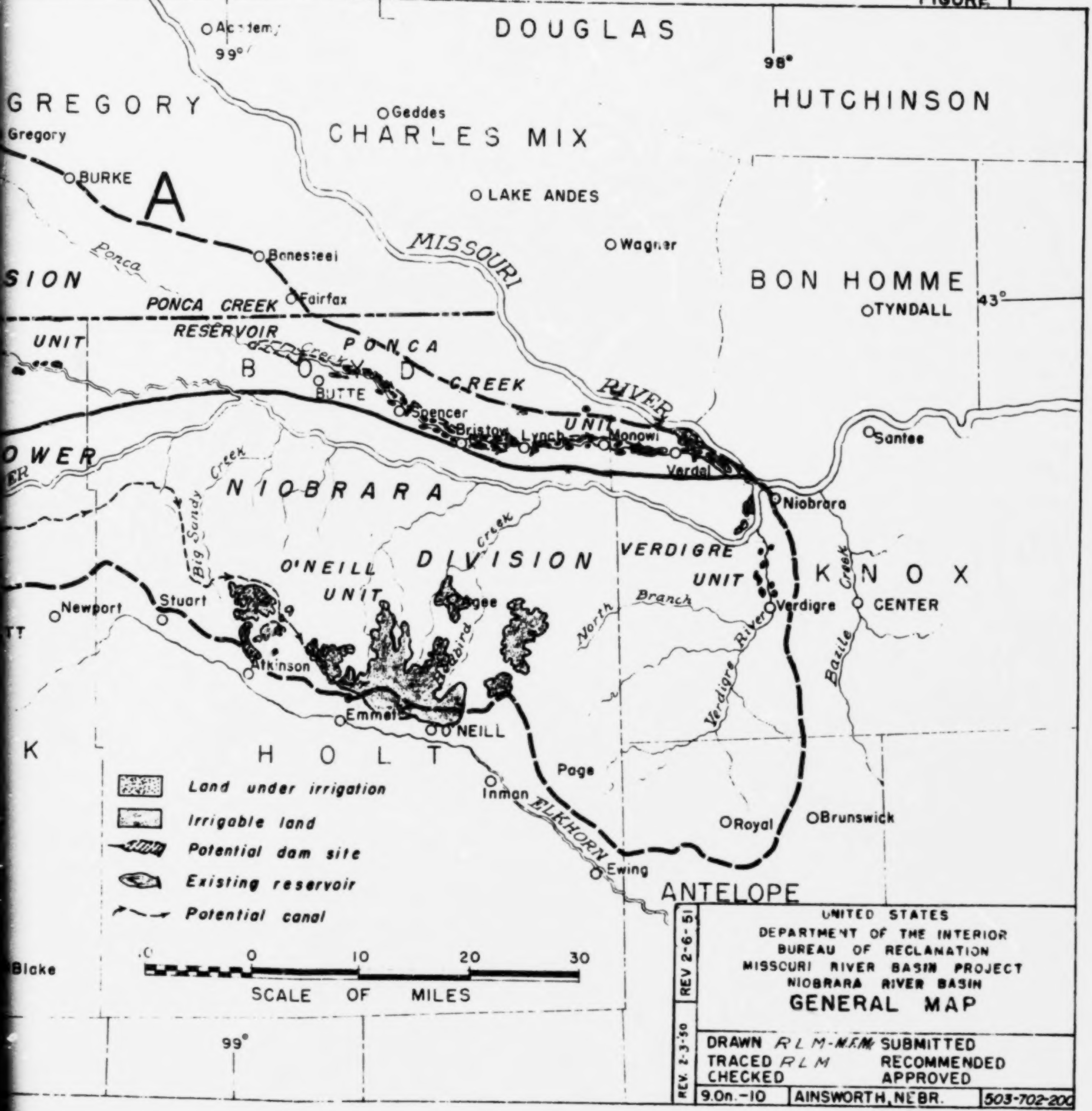

WINNER
100°
TRIPP
GREGORY
Academy
99°
DOUGLAS
Geddes
CHARLES MIX
Gregory
BURKE
LAKE ANDES
KOTA
Keya Pana
Ponca
MISSOURI
Wagner
PAHA
DIVISION
Wewela
Bonesteel
Fairfax
PONCA CREEK
RESERVOIR
PONCA
River
UNIT
Creek
BOYD
BUTTE
CREEK
RIVER
KEYA PAHA
Norden
Spencer
Bristow
Lynch
UNIT
Monowi
Verdel
SPRINGVIEW
UNIT
SPRINGVIEW
LOWER
NIOBRARA
Meadville
MEADVILLE
RESERVOIR
Riverview
RIVER
NIOBRARA
Big Sandy Creek
Creek
LONG PINE
RESERVOIR
O'NEILL
UNIT
DIVISION
VERDIGRE
UNIT
Stuart
Newport
BASSETT
Johnstown
AINSWORTH
Long Pine
Atkinson
Emmet
O'NEILL
Chambers
Redbird
North Branch
Verdigre
BROWN
ROCK
HOLT
Page
Inman
ELKHORN
Ewing
ANTEL
Land under irrigation
Irrigable land
Potential dam site
Existing reservoir
Potential canal
0 10 20 30
SCALE OF MILES
Calamus
River
Duff
Mary
Blake
Koshopah
K A
100°
99°
REV 2-6-51
REV. 2-3-50
DRAW
TRAC
CHEC
9.On.

FIGURE 1


DOUGLAS
HUTCHINSON
GREGORY
Gregory
CHARLES MIX
Academy
99°
98°
Geddes
BURKE
A
LAKE ANDES
Wagner
Ponca
Bonesteel
MISSOURI
SION
Fairfax
BON HOMME
TYNDALL
43°
PONCA CREEK
RESERVOIR
UNIT
Creek
PONCA
BOYD
CREEK
BUTTE
Spencer
Bristow
Lynch
UNIT
Monowi
RIVER
Verdel
Santee
OWER
Big Sandy Creek
NIOBRARA
Niobrara
DIVISION
Creek
O'NEILL
UNIT
VERDIGRE
UNIT
KNOX
Newport
Stuart
Chambers
Verdigre
CENTER
North Branch
Bazile Creek
Redbird
Atkinson
Verdigre River
Emmet
O'NEILL
K
HOLT
Page
Inman
ELKHORN
Royal
Brunswick
Ewing
ANTELOPE
TT
Blake
99°
Land under irrigation
Irrigable land
Potential dam site
Existing reservoir
Potential canal
10 0 10 20 30
SCALE OF MILES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MISSOURI RIVER BASIN PROJECT
NIOBRARA RIVER BASIN

GENERAL MAP

REV 2-6-51

REV. 2-3-50

DRAWN *RLM-MEM* SUBMITTED
TRACED *RLM* RECOMMENDED
CHECKED APPROVED

9.On.-10 | AINSWORTH, NEBR. | 503-702-200

Topography

The topography in northwest Nebraska and eastern Wyoming is characterized by flat to undulating tabular divides and eroded slopes which range from gentle to steep. At Lusk, Wyoming, the elevation is 5,200 feet above sea level. In central and western Nebraska, the surface configuration predominating is a monotonous succession of dune hills and ridges with occasional intervening valleys, pockets, and swales, many of which include grassy meadows. The region has many small lakes and ponds. Elevations range from 1,500 to 2,500 feet above sea level. To the east, 420 miles downstream from Lusk, Wyoming, the Niobrara River enters the Missouri River at an elevation of 1,200 feet above sea level.

Ponca Creek rises in the table lands of Tripp County near Colome, South Dakota, at an elevation 2,200 feet above sea level and flows generally eastward to a point 5 miles above Niobrara, Nebraska, where it discharges into the Missouri River at an elevation of about 1,200 feet above sea level. The creek meanders across its valley floor and makes numerous tortuous bends approximately one mile apart.

Climate

Semihumid conditions exist at Niobrara, Nebraska, near the Missouri River, where the average annual precipitation is about 22 inches. Wide ranges in temperature occur, varying from -38° to 116° F. The growing season is about 160 days. At Valentine, Nebraska, which is 150 miles westward, the average annual precipitation drops to approximately 19 inches. Snowfall averages increase from 11.5 inches at Niobrara to 31.5 inches at Valentine. Temperature records show extremes of - 38° to 108° F. Approximately 154 days constitute the growing season. At Lusk, Wyoming, temperature varies from -35° to 105° F.; there are about 115 days between killing frosts; and the average annual precipitation is about 14.5 inches.

Hydrology

Annual precipitation varies over the area from 14.5 to 22 inches, being low in the west and increasing eastward toward the Missouri River. Runoff originating in the hill regions is supplemented by percolating waters from the vast underground reservoir of the Sand Hills Region. Professor A. L. Lugn[1] of the University of Nebraska has estimated the capacity of this ground water storage at 600,000,000 acre-feet and an additional amount varying from 50-75,000,000 acre-feet in the Box Butte area. The discharge of the streams receiving flow from this ground water source is perennially uniform. Flow fluctuations do occur from month to month but the annual discharge of the Niobrara River, which is about 1,000,000 acre-feet, shows only slight variation.

---

[1] Lugn, A. L. -- "Ground Water in Nebraska", Unpublished Report. Similar article "Ground Water Worth Millions", published in *Nebraska Farmer* (Feb. 22, Mar. 8, Mar. 22, 1941).

The average fall of the Niobrara River is about 9.5 feet per mile. Hydrological records generally are incomplete and resort has been made to unpublished reports particularly in the case of tributary streams.

The runoff of Ponca Creek has not been systematically recorded. Experience data as provided by inhabitants of the area show that Ponca Creek discharges are relatively small normally and that the creek has been known to go dry in drought periods. Contributing flow by tributaries is intermittent. The average gradient of Ponca Creek exceeds eight feet per mile from the mouth to the Nebraska-South Dakota State Line and gradually decreases to about six feet per mile at the headwaters.

ECONOMIC DEVELOPMENT

The Niobrara River Basin is almost wholly dependent upon an agricultural economy with livestock production the largest source of income. The land is devoted primarily to grazing and the growth of fodder. Some diversified farming is followed in Goshen County, Wyoming, where sugar beets and dry beans are produced upon irrigated land.

Irrigation has not been instituted on a large scale. The first major irrigation venture, Mirage Flats development, provides water for 12,000 acres of land south of Hay Springs, Nebraska. Farm products in 1949, in the counties which comprise the Basin, had a total value of $28,647,000; manufactured products, a value of $2,314,000; and the wholesale and retail merchandising business an estimated worth of $10,000,000. About 60,000 people inhabited the Basin in 1940; populations of municipalities are listed in table 2. Five of these communities, Ainsworth, Valentine, Gordon, and Rushville, in Nebraska; and Lusk, in Wyoming, have populations in excess of 1,000. Of the remaining, 10 fall below the 500 population mark.

Ponca Creek Valley also depends upon agriculture for its livelihood, mainly dry farming and cattle raising. In the headwater regions of Tripp County and on some of the uplands in the lower Basin, wheat and small grains are the principal crops. The cultivated bottomlands are devoted to the growing of corn, wheat, oats, barley, alfalfa, potatoes, and rye. The Valley is inhabited by approximately 5,000 people. The largest communities are Gregory, South Dakota, and Spencer, Nebraska (table 2). Population density is low with an average of six people per square mile.

USES OF WATER RESOURCES

Municipal Water Supplies

Public water supplies for domestic and industrial use are generally

Table 2. Population of municipalities

		Population - U. S. Census			
Municipality	State	1920	1930	1940	1949 (est.)
Niobrara River Basin					
Ainsworth	Nebraska	1,508	1,378	1,833	2,500
Cody	Nebraska	428	408	375	404
Crookston	Nebraska	-	373	262	250
Gordon	Nebraska	1,967	1,958	1,967	2,000
Hay Springs	Nebraska	819	853	819	825
Hemingford	Nebraska	792	1,025	792	800
Johnstown	Nebraska	290	229	173	175
Kilgore	Nebraska	274	232	173	160
Long Pine	Nebraska	1,200	937	824	800
Marsland	Nebraska	165	175	123	110
Merriman	Nebraska	346	362	321	330
Royal	Nebraska	193	217	193	200
Rushville	Nebraska	1,125	1,006	1,125	1,125
Springview	Nebraska	354	307	347	345
Valentine	Nebraska	1,596	1,672	2,188	2,500
Verdigre	Nebraska	556	618	556	600
Wood Lake	Nebraska	323	293	323	350
Mission	South Dakota	-	-	452	-
Lusk	Wyoming	2,092	1,218	1,814	-
Ponca Creek Valley					
Butte	Nebraska	-	569	623	-
Lynch	Nebraska	-	498	487	487
Spencer	Nebraska	-	653	635	635
Verdel	Nebraska	-	155	108	108
Bonesteel	South Dakota	-	564	532	-
Burke	South Dakota	-	605	602	-
Colome	South Dakota	-	599	509	-
Dallas	South Dakota	-	423	278	-
Fairfax	South Dakota	-	430	338	-
Gregory	South Dakota	-	1,034	1,246	1,034
Herrick	South Dakota	-	339	246	-

obtained from ground water resources; Verdigre being the only user of surface water supply. The Sand Hills Region reportedly has a vast subsurface reservoir underlying its porous cover which provides an adequate supply of ground water. Hay Springs obtains its water supply from three wells which tap another aquifer. The use of wells for cattle watering is also widespread. Suitable ground water in Ponca Valley may be limited, forecasting a possible move toward utilization of surface supplies.

Agriculture

The Mirage Flats Project is the only major existing irrigation development in the Basin; however the Bureau of Reclamation is conducting studies to determine the feasibility of developing additional units. Well irrigation has been increasing, particularly in the Ainsworth area. Quality of water for irrigation ranges from good to excellent.

Most livestock in the region is watered from numerous small natural ponds and lakes which prevail in the Sand Hills Region.

Hydroelectric Power

Five hydroelectric power plants are in operation at the present time, two on the main stem of the Niobrara and three on its tributaries. The Corps of Engineers[1] has investigated the constant discharge characteristics of the Niobrara River and has considered the installation of five low-head power dams in the lower reaches of the main stem to utilize these potentialities. These dams may also have some flood control value. Power is now imported for use inside the Basin.

The program of the Bureau of Reclamation envisions hydroelectric power production at Eli, Kilgore, Crookston, Thacher, Sparks, Meadville and Long Pine Reservoirs.

Recreation - Fish and Wildlife

Existing outdoor recreational facilities in the Niobrara River Basin are limited, especially those associated with water activities. If constructed, the reservoirs now being studied by the Bureau of Reclamation will substantially increase the recreational potentialities of the basin. It appears that most of the reservoirs will warrant some development for day use activities and that Long Pine and the Thacher sites will warrant more extensive development with provision for both day and vacation use. A minor day use area is now being planned for the existing Box Butte Reservoir in the western portion of the basin. It is considered that the recreational development at these sites will be chiefly local in significance.

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[1] Corps of Engineers. House Document No. 90, 73rd Congress, 1st Session.

The Niobrara River is poorly adapted to fish because of its silt characteristics, and further development will depend largely upon the stocking of impounded areas for fish. Ft. Niobrara National Wildlife Refuge is located on the Niobrara River. The reservoir development program would result in an inundation of essential cover for big game, upland game and fur-bearing animals, and would require replacement of cover to alleviate such losses. Waterfowl refuges could be developed readily in connection with the proposed reservoirs.

Table 3. Reservoir data

Reservoir	Stream	Approximate miles to mouth Niobrara River	 Tributary stream	Purpose
Niobrara River Basin				
Existing:				
Spencer	Niobrara	39		Hydroelectric power[1]
Long Pine	Long Pine Creek	96	18	Hydroelectric power[1]
Power Plant	Plum Creek	109	5	Hydroelectric power[1]
Valentine	Minnechaduza	146	5	Hydroelectric power[2]
Valentine	Niobrara	150		Hydroelectric power[2]
Box Butte	Niobrara	306		Irrigation[2]
Potential:				
Long Pine	Long Pine Creek	96		Hydroelectric power[2]
Meadville	Niobrara	107		Irrigation & Hydroelectric power[2]
Sparks	Niobrara	136		Hydroelectric power[1]
Thacher	Niobrara	145		Hydroelectric power[2]
Crookston	Niobrara	161		Hydroelectric power[2]
Merritt	Snake River	169	12	Irrigation
Kilgore	Niobrara	179		Hydroelectric power[2]
Eli	Niobrara	207		Irrigation & Hydroelectric power[2]
Colwell	Niobrara	305		Irrigation[2]
Ponca Creek Valley[3]				
Potential:				
Ponca Creek	Ponca Creek		40	Irrigation, flood control[2]

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[1] Data from Biennial Report, Nebraska State Bureau of Irrigation, Water Power and Drainage.

[2] Status data from Bureau of Reclamation.

[3] Projects in Ponca Valley are in a deferred status.

RESERVOIR AND DIVERSION DAM PROJECTS[1]

The tentative program of the Bureau of Reclamation includes the use of streams of the Niobrara River Basin for development of additional irrigated acreage, hydroelectric power, stream regulation, fish and wildlife and public health and sanitation.

Existing and proposed reservoirs are listed in table 3. Box Butte Reservoir is the only existing impoundment in operation for irrigation purposes.

Table 4 lists the diversion dams. The one existing structure at Dunlap directs flow from the Niobrara River to the Mirage Flats irrigation project.

Table 4. Diversion dam data

Diversion Dam	Stream	Approximate miles above mouth: Niobrara River	Approximate miles above mouth: Tributary Stream	Status[1]
Meadville	Niobrara River	107		P
Merritt	Snake River	169	12	P
Dunlap	Niobrara River	298		E

[1]Status - E - Existing
P - Proposed

Existing Projects

Box Butte Dam located on the Niobrara River about eight miles north of Hemingford, Nebraska, impounds water for the Mirage Flats Irrigation Project in Sheridan County 12 miles south of Hay Springs, Nebraska. Approximately 12,000 acres of land are serviced by water stored in the Reservoir which has a capacity of 31,200 acre-feet. Water from Box Butte is diverted at Dunlap Diversion Dam, situated about 8 miles downstream from the Reservoir, and passes to Mirage Flats Canal which feeds the distribution system of the project.

Pump irrigation has been used recently in the vicinity of Ainsworth, Nebraska.

Potential Projects

A review of potential developments, as included in the plan of the

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[1] The words proposed and potential are used interchangeably. In conformance with the intent of the Comprehensive Plan of the Niobrara River Basin of the Bureau of Reclamation, both should bear the portent of the word potential.

Bureau of Reclamation, is presented to indicate the contemplated water use in the Basin. The plan is not final and is subject to change contingent upon future developments by the Bureau of Reclamation.

Potential Colwell Dam, to be installed below existing Box Butte Reservoir, would provide storage capacity for irrigating about 6,000 acres of land. This area would comprise an extension to existing Mirage Flats Project.

Southeast of Gordon, Nebraska, a potential pumping plant would supply water to about 3,300 acres of land.

Potential Eli Dam, on the Niobrara River south of Eli, Nebraska, would store water for irrigation and hydroelectric power. Returned flow would pass to potential Kilgore Reservoir to be stored for hydroelectric power, and stream flow regulation purposes. Below Kilgore Dam potential Crookston, Thacher, Sparks, and Meadville Dams would be used to impound Niobrara River water for irrigation, hydroelectric power and stream flow regulation.

Potential Merritt Dam across Snake River would impound water for irrigation purposes. Potential Long Pine Reservoir on Long Pine Creek would also act as a storage structure for production of power.

In Ponca Creek Valley, potential Ponca Creek Dam, for which development plans have not yet crystallized, will be a multiple-purpose unit.

REVIEW OF STATE WATER POLLUTION LAWS

A critical review of the water pollution laws of Nebraska, South Dakota, and Wyoming is presented, together with information regarding pending legislation. Information on the general subject of State water pollution control legislation including a suggested State water pollution control act and the explanatory statement is presented in appendix A.

Nebraska

Summary

Nebraska has specific need for the enactment of comprehensive water pollution control legislation based on the fundamental principles upon which the suggested State Water Pollution Control Act (appendix A) has been developed. The existing State water pollution laws are inadequate for present day needs. The powers of the State Health Department should not be limited to the public health aspects of water pollution. They should apply to all pollution detrimental to water use and there should be no division of authority. Enabling legislation for cities appears to be adequate. Sanitary districts can be formed. The State's water pollution control program has accomplished considerable improvement but much remains to be done. Serious handicaps to this program have been lack of personnel and inadequate laws. Both of these deficiencies should be corrected.

Administrative Authority

Nebraska does not have a comprehensive water pollution law and there is no statutory requirement for the development of a broad water pollution control program or the administrative enforcement thereof. Comprehensive water pollution control legislation should be enacted as soon as possible. The only statutory authority for water pollution control in Nebraska is given in Section 81-602, Revised Statutes of Nebraska which states, "The Department of Health shall have general supervision and control over matters relating to public health and sanitation . . . . ."

The State Health Department is authorized by this statute to adopt reasonable rules and regulations as will best serve to promote sanitation throughout the State.

Definitions

Definitions of the terms "pollution", "wastes", "sewerage system", "treatment works", "disposal system", etc., should be included in comprehensive water pollution legislation adopted for Nebraska. (See appendix A).

Section 37-516, Revised Statutes of 1943, defines "refuse" as all substances harmful to aquatic life and forbids its discharge into the waters of the State. However, this statute exempts corporations, villages, and cities of the second class discharging sewage or refuse prior to August 21, 1931 and is not of great value to a general pollution control program.

Powers and Duties

Comprehensive Programs: Cooperation - The powers and duties of the State Health Department, as far as water pollution is concerned, are administered through the Sanitation Division of the Health Department whose functions are principally advisory and educational. As now administered these powers and duties relating to water pollution control appear to be limited.

The Nebraska State Health Department, while not specifically authorized to do so by statute, does cooperate with various State and Federal agencies in connection with water pollution control problems. Such cooperation should be authorized by statute.

Investigations - The State Health Department conducts water pollution investigations under the very general authority granted to it by the statutes. More specific authority would be desirable (appendix A).

Stream Standards and Classification - There is no specific authority for classification of waters according to use or the adoption of stream standards. Section 81-602 might possibly be construed to grant this authority, but specific legislation is needed.

Rules and Regulations - General health department authority for the adoption of rules and regulations is contained in Section 81-602. Specific statutory authority in the field of water pollution should be given to a water pollution control authority (see appendix A).

Permits - No permit system is now in operation. Such a system is considered administratively desirable and should be included in future water pollution control legislation.

Orders for Pollution Abatement - There is no specific authority provided by statute. Presumably, however, the State Health Department could act if there was a serious public health hazard. Specific statutory authority is needed. This authority should cover all forms of water pollution and should not be limited to public health problems alone (appendix A).

Plans and Specifications - Submission is required by the State Health Department rules and regulations for systems serving more than 25 persons. No mention is made of plans for industrial waste treatment plants, however.

Federal Water Pollution Control Act - There is no specific statutory authority for cooperation with the Federal Government in connection with the Federal Water Pollution Control Act.

Division of Authority - There is some division of authority and responsibility between the State Fish and Game Agency and the State Health Department. The State Fish and Game Agency may take action through county attorneys to secure abatement of pollution harmful to aquatic life. In the enactment of comprehensive water pollution control legislation, a single State agency should be designated and its powers should be broad enough to include this and all other types of water pollution problems.

Enforcement

Penalties are provided for failure to comply with the Health Department's rules and regulations. Fines vary from $15 to $100 for each offense. As far as water pollution is concerned, enforcement provisions appear to be deficient. This phase of a comprehensive pollution law is important and should be strengthened in future legislation (see appendix A).

Sanitary Districts

Section 31-701, et seq, Revised Statutes, Supplement, 1947, indicate that sanitary districts may be formed and that such districts may provide for the construction and maintenance of necessary sewage works. (Certain areas may not be included in such districts). General obligation bonds up to 10 percent of the assessed valuation of taxable property may be issued. Revenue bonds may also be used to finance such projects and in such cases the 10 percent limit does not apply.

Statutes Governing Financing of Pollution Abatement Works

All villages and cities may issue "mortgage bonds" (Section 18-502). These bonds do not impose any general liability upon the municipality and are secured by the property; e.g., the sewage works, and revenues derived therefrom. This is the equivalent of sewer service charge financing and is undoubtedly of considerable value to the municipalities in financing sewage treatment works.

All cities and villages are authorized by Section 18-501, et seq, to own, construct, equip and operate sewage works within or outside the city or village. They may condemn the lands needed, levy taxes, issue bonds, or as previously noted, mortgage bonds in accordance with statutory provisions. Cities and villages may also adopt rules and regulations governing the use of sewers and treatment plants and charges for the use of same. If the charge is not paid, the city or village may recover by action of assumpsit or the charge may be certified to the tax assessor and assessed against the property served.

Municipal finance laws do not appear to have retarded the progress of water pollution control in Nebraska.

Water Pollution Control Program

Nebraska has a fairly good record in water pollution control and the State Health Department enjoys the confidence of State and city officials, and the public at large. Undoubtedly the State's program has been seriously handicapped by inadequate statutory backing. There is a definite need for adequate legislation. The educational aspects of the program should be improved. The holding of hearings may be desirable tc intimately acquaint the public with pollution control program and to gage public opinion regarding pollution abatement procedures. Legal action against extremely recalcitrant cases may be indicated.

Another serious handicap has been lack of a sufficient number of competent engineers on the State Health Department's staff. Present key personnel are experienced and competent but cannot handle the work throughout the State unaided. Funds should be provided for increasing the engineering staff assigned to pollution control work.

Of the total Nebraska population served by sewer systems, about 46 percent are tributary to sewage treatment plants. Of the cities having sewer systems, about 56 percent provide treatment. Similar national statistics indicate that about 63 percent of the sewered population are served by treatment facilities and that about 61 percent of the sewered communities provide treatment.

South Dakota

Summary

The South Dakota code provides for a committee on water pollution control. Technical work relating to water pollution is done under the direction of the Director of the Division of Sanitary Engineering of the State Department of Health. There is no specific statutory authority for the development of a comprehensive program in the field of water pollution control; nevertheless, substantial progress has been made in abatement and prevention of pollution. There appears some overlapping of activities and authority between the committee and State Department of Health. The State's water pollution control program has been, in general, quite effective. A limited staff has restricted the scope of certain phases of the program.

Administrative Authority

The South Dakota code provides for a committee on water pollution consisting of the Superintendent of the State Department of Health, the State Engineer and the Director of Game, Fish and Parks Department. Except as specifically provided, all technical work relating to water pollution shall be done under the direction of the Director of the Division of Sanitary Engineering of the State Department of Health.

Powers and Duties

Comprehensive Programs: Cooperation - Neither the department nor the committee has specific statutory authority to develop comprehensive programs. It may be desirable to have the committee on water pollution directed by statutory mandate to develop comprehensive programs for the prevention, abatement and control of water pollution and to look toward interstate, Federal and local cooperation wherever possible to achieve these ends.

Investigations - Investigations may be ordered by the committee on stream pollution. While these investigations are specifically directed in a large measure toward "Class A" waters, there appears no specific limitation on investigations of "Class B" waters.

Stream Standards and Classifications - Present legislative classification of waters divides public waters of the State into Class A and Class B waters. Classification of waters is a duty of the committee on water pollution. It is suggested that any legislative changes made in the water pollution control law authorize classification to be made by the administrative agency rather than be written in the legislation.

Rules and Regulations - The committee on water pollution has comprehensive authority for enforcing the State's abatement laws. Authority in this field is also provided for and exercised by the State Department of Health. Any revision of the South Dakota Statutes might consider the possibility of eliminating this overlapping.

Permits - The powers of granting permits by the committee on water pollution are specifically directed in a large measure toward Class A waters. No new discharge which causes any new pollution or corruption in the form of sewage, industrial or other wastes, liquid or solid, without first having been given a permit by the water pollution committee shall be allowed. The State Department of Health by regulation requires approval by it of the plans of any disposal system before such construction may take place.

Orders for Pollution Abatement - The committee on water pollution has comprehensive authority for enforcing the State's pollution laws. The State Department of Health is also provided with authority in this field. The committee does not appear to have the statutory right to issue summary orders in the case of emergencies but does have the authority to issue administration orders after hearings. Specific authority is required and should cover all forms of pollution and all classifications of waters.

Plans and Specifications - The State Department of Health by regulation requires approval by it of the plans of any disposal system before such construction may take place.

Division of Authority - Overlapping of authority exists in the enforcement of the State's water pollution laws. Both the committee on water pollution and the State Department of Health possess authority in this field. In the enactment of legislation for a comprehensive water pollution control program, a single State agency should be designated with powers broad enough to include this and all other types of water pollution problems.

Enforcement

A fine and/or imprisonment is not provided for by statute for the violation of any of the orders of the committee. In the development of a comprehensive program sanctions against pollution would be provided for and would include punishment by fine and/or imprisonment. Investigations and hearings should be provided for under statute and the pollution agency should be empowered to bring legal action against offenders.

Water Pollution Control Program

For many years South Dakota has been active in water pollution control and at present is conducting stream pollution investigations within the State in cooperation with other States. Approximately 80 percent of the population tributary to sewerage is served by treatment plants and 72 percent of the sewered communities treat their wastes. This compares with 63 percent and 61 percent, respectively, on a national basis. The statistics reflect the general shortage of surface waters with a resultant need for sewage treatment, and an aggressive State Department of Health in pollution control.

An increase in the educational activities of the water pollution control agency may prove beneficial. While existing legislation is subject to certain defects, much has been and can be accomplished under current law. Hearings are excellent means to acquaint the public with the needs and benefits of pollution abatement. It may be desirable for the control agency to act to abate pollution to the fullest extent permitted under existing law.

Wyoming

Summary

The State Board of Health, within the Department of Public Health, has been designated as the water pollution control agency for Wyoming. However, there is some division of authority and responsibility with the Game and Fish Commission in matters of water pollution control.

The State Board of Health has extensive powers and there are no statutory provisions for exemption from its jurisdiction.

There is no comprehensive water pollution control law in Wyoming. Review and approval of plans and specifications by the Board of Health is provided by statute. Adequate enforcement provisions appear to be provided by statute. Lack of satisfactory water pollution control law, insufficient personnel and inadequate funds have hampered efforts on water pollution control.

Administrative Authority

Administrative authority and responsibility are vested in the State Board of Health which has extensive powers. Relevant statutes are contained in S 63-112, 201-212, Wyoming Compiled Statutes Annotated, 1945. There are no exemptions from the jurisdiction of the State Board of Health provided for by the State statutes. However, the Indian Service assumes jurisdiction on Indian reservations for sewage disposal.

Definitions

Chapter 63-204, Wyoming Compiled Statutes, 1945, defines the term "drainage" as meaning rainfall, surface and subsoil water only, and "sewage" as meaning domestic and industrial filth and waste.

Powers and Duties

Comprehensive Programs: Cooperation - There is no statutory mandate for the development of a comprehensive program, for the prevention, control, and abatement of water pollution; such provision is deemed to be most desirable, and should be considered if recommendations are to be made suggesting statutory changes.

There is no specific statutory authority to cooperate with other States and the Federal Government. However, a pattern of cooperation with Federal agencies seems to be indicated by the biennial reports of the Wyoming Board of Health. It may be deemed desirable to provide by statute for such cooperation with the Federal Government and other States in the development of a comprehensive program.

Investigations - The State Board of Health may make investigations and issue orders, rules and regulations.

Stream Standards: Classification - There is no statutory mandate for the setting of standards of water purity and the classifying of waters according to their particular uses. Presumably this may be done under the present authority to issue regulations, however, a statutory mandate to this effect may be considered.

Rules and Regulations: Hearings - There is no provision for a hearing, but in conducting investigations the Board has the power to summon witnesses, administer oaths, and hear evidence, and the investigations may be conducted in the same manner as hearings. It is to be noted that the basic Act was passed in 1923. Since that time the value of conducting hearings has become more apparent. If any change in the statute is contemplated, consideration should be given to requiring hearings by statute unless they are already afforded by administrative action under the power to conduct investigations.

Permits - Statutory requirements for a permit system is contained in Sections 63-204; 63-205; 63-206.

Orders for Pollution Abatement - Upon complaint, the Department of Public Health may issue orders prohibiting the continuance of any pollution rendering a water supply unfit for domestic use and requiring the removal of such cause of pollution (sec. 63-207). Presumably the department may also issue orders on its own motion. Persons aggrieved may appeal to the district court (sec. 63-209).

Plans and Specifications - Review and approval of plans and specifications by the Board of Health is provided by statute. Anyone operating a railroad, logging road, logging camp, electric plant, manufacturing or industrial plant of any kind upon or over any watershed of any public supply system is subject to these provisions. Any revision should remove limitations on who requires permits. Discretionary coverage of permits should be set up by law and administered by the water pollution control agency (see appendix A).

Division of Authority - Among the general powers and duties of the Game and Fish Commission is the power to "supervise the waters of the State pertaining to the protection, management, and propagation of fish." (sec. 47-110).

Criminal statutes make it unlawful to discharge any deleterious substance that might tend to destroy the fish or pollute or render the waters unfit for domestic, irrigation, stock, or any other purpose (sec. 47-507). Sec. 9-220 makes it unlawful to poison any spring, well or reservoir with intent to kill or injure a human being.

The powers of the State should be extended by statute to cover all types of pollution and thus center all pollution control work in a single agency.

Enforcement

Adequate investigatory powers, sanctions, and judicial review, appear to be provided for by statute.

Sanitary Districts

Specific statutory authorization for the formation of sanitation districts outside of incorporated areas was provided by the legislature in January 1950. Apparently there are adequate provisions for the formation of districts within corporate limits.

Statutes Governing Financing of Pollution Abatement Works

Wyoming has a comprehensive revenue bond law applicable to sewerage works. General obligation bonds may also be used for financing sewerage works but the total outstanding indebtedness which can be incurred by this method is limited to four percent of the assessed valuation of taxable property by constitutional limitation. This limitation does not apply to revenue bonds. Sanitation districts are authorized to issue general obligation bonds limited to 10 percent of the assessed valuation, but this provision in the act is questioned on constitutional grounds. Revenue bond issues authorized for sanitation districts are not limited. It appears that Wyoming has adequate financing for construction of public pollution abatement works.

Complaints

The Board of Health is required to investigate complaints of the mayor or health officer of any city or town or the managing board or officer of any public institution or the president of an ice company relating to pollution of water used as a source of water supply used by them. It is suggested that these restrictions be removed and that the water pollution control agency be permitted to administratively determine when investigations are necessary.

Water Pollution Control Program

The State is showing increased activity in the matter of water pollution control. A major investigation has recently been completed and others are contemplated within the limitations of available funds and personnel.

The educational activities of the water pollution control agency should be increased and intensified. Wyoming, being a tourist State offering a wide variety of recreational pursuits, must protect its vital natural resources. Accordingly, the State has considerable need for adequate treatment of sewage and industrial wastes. The State water pollution control agency should hold hearings to publicize these needs and provide for pollution abatement to the extent permitted under existing law. Efforts to secure new stream pollution legislation is indicated.

Only about 37 percent of the sewered population in the State (1940) are served by sewage treatment of some sort. The national average is about 63 percent. Less than half (43 percent) of those communities with sewer systems provide some type of sewage treatment as compared with the national average of about 60 percent. There would appear, from these figures, to be quite a fertile field among the cities and towns of Wyoming for promotion of water pollution abatement activities.

SURVEY METHODS

The investigation of water pollution and water utilization in the Niobrara River Basin and Ponca Creek Valley included:

(a) Field investigations to secure most recent and accurate information regarding (1) water supplies and water utilization, and (2) sources of pollution including sewage treatment, sewage discharge and industrial wastes.

(b) Sampling program and laboratory determinations to secure various physical, chemical and bacteriological information on stream conditions as a means of correlating actual stream characteristics with sources of pollution.

(c) Stream discharge data at time of sampling so that laboratory results could be evaluated quantitatively with sources of pollution.

(d) Assembly and review of existing information.

Field Investigations

Engineering surveys of water supplies and sources of pollution were conducted by Sanitary Engineers from the State Health Departments and the Public Health Service.

Water Supply

The water supply data collected for each municipality included information on the source of supply, treatment if any, population served, and average daily consumption. Latest population estimates were employed in most cases to arrive at the population served by water systems. Industrial and agricultural uses of water were also noted.

Sources of Pollution

Domestic Sewage - For each municipality, the data gathered included the sewered population, type and degree of treatment if any, and the name of the receiving body of water. The percentage of B.O.D. removal by treatment plants, where records or supplemental information were not available, was generally taken as 35 percent for primary treatment and 75 percent for secondary treatment. However, the judgment and experience of the investigating engineer were depended upon to evaluate treatment processes where inspection indicated exceptionally good results, an overloaded plant, insufficient or faulty operation. At Ainsworth, Nebraska, composite samples of raw and treated sewage collected over a 24-hour period were analyzed to determine the sewage treatment plant efficiency.

Industrial Waste - All industrial establishments discharging a significant pollutional waste were investigated to secure information in sufficient detail to permit a quantitative evaluation of the waste load. Survey forms included the following information: type of industry, location, operation (with seasonal variation), water supply, quantity of raw materials, quantity of finished products, treatment of wastes if any, and the name of the receiving body of water. Industry in this area consisted primarily of small dairies and one slaughter house.

Sewered Population Equivalent - The strength of the industrial waste was expressed as population equivalents based upon 0.167 pounds per day of 5-day, 20° C., Biochemical Oxygen Demand (B.O.D.) per person. To arrive at the population equivalent of sewage produced by a given community, population equivalent units of industrial wastes were added to the sewered population. The strength of the waste discharged was computed as the sewered population equivalent minus any treatment either by the municipality, industries, or combined.

Stream Evaluation

Sampling Procedure - Stream sampling points were established at water supply intakes, above and below sources of known or suspected pollution, in the vicinity of existing or proposed dams and diversions, at points where other water uses might develop, and at suitable points along tributaries (see figures 4 and 5).

Sampling was conducted to secure a representative portion of the stream in question. The samples were drawn from the main channel or channels and, if at all possible, from mid-depth. A copper depth sampler was employed for this purpose. A special pole-type sampler was used in shallow streams and dip samples were collected when the water was too shallow to use the pole sampler.

The sample collector, at the time of sample collection, recorded the time of day to the nearest minute, determined the temperature of the water to the nearest degree centigrade, staged the stream, recorded as "remarks" any unusual stream conditions, noted the presence of possible sources of pollution, and recorded other pertinent information.

Samples were transported iced in a special carrying case in the truck or car. Samples were placed in the carrying case as soon as collected and remained there until ready for analysis, usually not longer than six hours.

Number of Sampling Stations - A total of 19 sampling points were established; 17 for the Niobrara River Basin of which 5 were on the main stem and 12 on the tributaries. Two sampling points were set up on Ponca Creek.

Stream Discharge Data

In order to correlate laboratory results with the pollution reaching the streams, it is necessary to secure actual stream discharge at the time of sampling. A list of the sampling stations and the weekly itinerary of sample collectors were forwarded to the Geological Survey. The sample collector read U. S. Geological Survey gages, made wire weight readings and determined stream heights from datum points established on bridges. Readings were made to the nearest one hundredth of a foot and recorded on data sheets. Record of sampling with the gage reading or stage height, time and date of sampling, sampling point location, and river mile index was submitted to the U. S. Geological Survey for flow determination. The District Office, U. S. Geological Survey, at Lincoln, Nebraska, cooperated by supplying the stream discharge data. Unfortunately, stream gaging in this area was not complete enough to provide flows for all sampling stations. At the request of the U. S. Geological Survey, temperature readings were submitted for their information and use.

Laboratory Operations

A Public Health Service mobile laboratory was stationed at Ainsworth, Nebraska. This unit arrived on location June 8, 1949; sampling and laboratory analysis started two days later and continued until June 29, 1949. The objective of this laboratory unit was to sample and analyze the waters of the Niobrara River, its tributaries and Ponca Creek. The normal complement of the mobile unit was one chemist-bacteriologist, a laboratory assistant, and a sample collector. Laboratory units located in the Lower Platte River Basin supplemented the activities of this laboratory.

Total Number of Determinations

One hundred and one samples were collected and 1,081 tests were made (table 5). In addition, analyses were made of samples composited during a 24-hour study of the Ainsworth sewage treatment plant.

Table 5. Laboratory determinations

	Niobrara River Basin	Ponca Creek Valley
Temperature	93	8
Dissolved Oxygen	85	8
Biochemical Oxygen Demand	85	8
Turbidity	93	8
Coliform Group Organisms	85	8
Alkalinity	93	8
Chloride	93	8
Ammonia Nitrogen	92	8
Nitrite Nitrogen	84	8
Nitrate Nitrogen	89	8
Phosphate	8	0
pH	93	8
Total	993	88

Laboratory Tests

Laboratory tests included temperature, turbidity, dissolved oxygen, biochemical oxygen demand, pH, alkalinity, chloride, ammonia, nitrite nitrogen, nitrate nitrogen, phosphate, and coliform group organisms.

Chemical and bacteriological examinations and analyses were in accordance with "Standard Methods for the Examination of Water and Sewage", Ninth Edition, 1946, of the American Public Health Association.

PRESENTATION OF DATA

Public Water Supplies

Verdigre is the only municipality in the Niobrara Basin that uses a surface source, the Verdigre Creek, for its public water supply (table 6). Five hundred people are served and the average daily consumption is 100,000 gallons.

Table 6. Municipal surface water supplies

Stream and Municipality	Miles above mouth Main Stem	 Tributary	Treatment[1]	Population served	Consumption M.G.D.
Niobrara River					
Verdigre Creek	5				
Verdigre		9	D	500	0.10

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[1] D - Chlorination

Fifteen Niobrara Basin communities are served by public water supplies from ground sources. Approximately 11,950 people utilize 2,812,000 gallons per day (table 7).

Municipal water supplies in Ponca Valley are also obtained from ground water sources. A population of 4,845 consumes 339,000 gallons daily for an average consumption of 70 gallons per capita daily (table 7). These data are illustrated graphically in figure 2.

Pollution Contributed to Water Resources

Sources of pollution are listed in table 8 and depicted in figure 3. The amount of waste produced and the reduction by treatment of domestic and industrial wastes is expressed in population equivalents. A total of 8,000 people in the Niobrara Basin are connected to sewers; the sewered population equivalent, including industrial wastes, is 10,755, which is reduced to 5,625 by sewage treatment plants. Eight municipalities discharge wastes to streams in the Niobrara Basin. Four communities have secondary treatment facilities, two have primary treatment plants and the remaining two discharge untreated sewage. Verdigre does not have community sewers, although the school house and one industry discharge to Verdigre Creek. Seventy-five percent of the communities discharging to streams treat their wastes. This compares very favorably with the national average of about 60 percent. Treatment effects a reduction of approximately 48 percent.

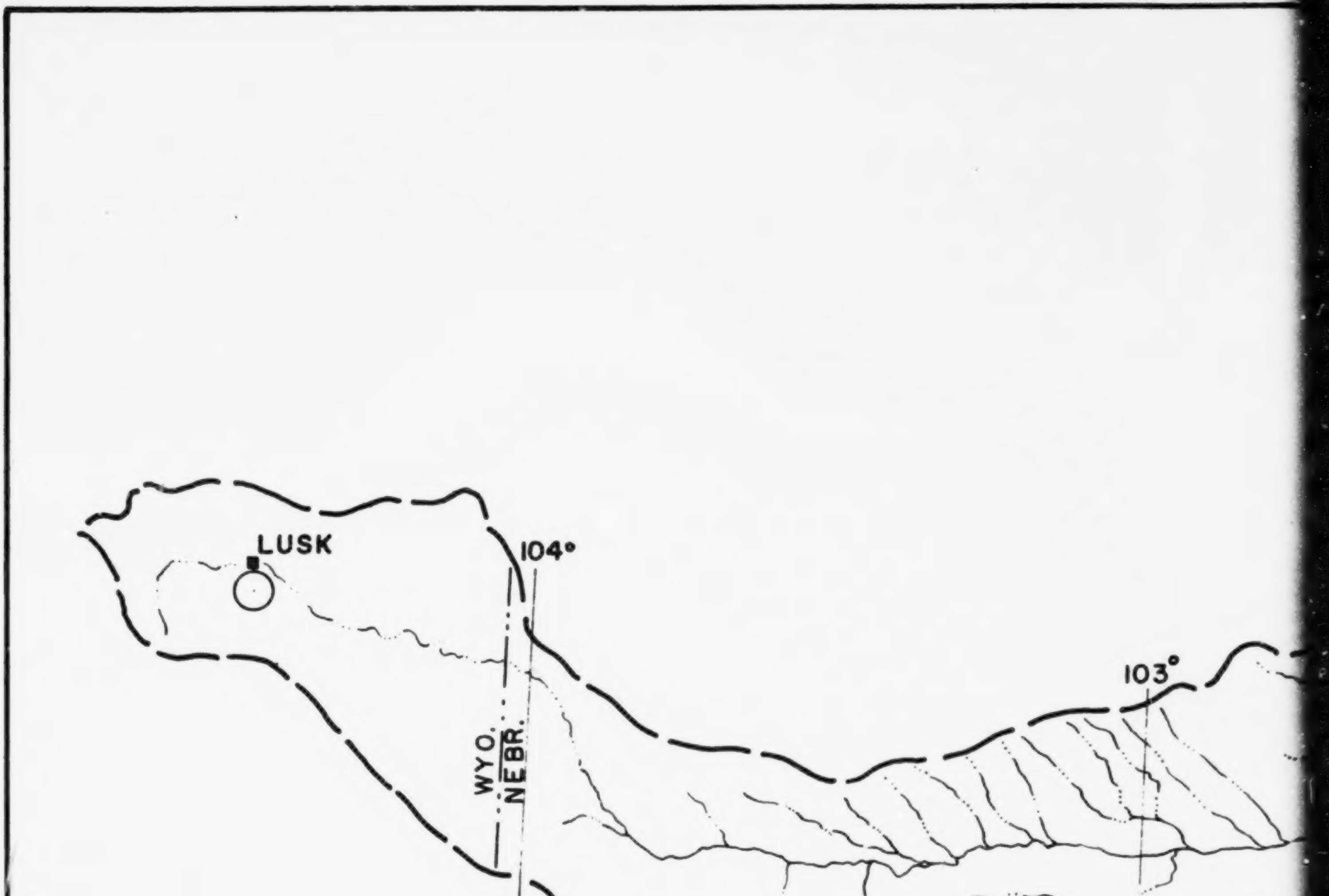
In Ponca Creek Valley two municipalities--Spencer, Nebraska, and Gregory, South Dakota--possess sewer systems. Spencer discharges 480

Table 7. Municipal water supplies from ground sources

Municipality	State	Source[1]	Treatment[2]	Population served	Average Consumption M.G.D.
Niobrara River Basin					
Ainsworth	Nebraska	W	N	1,650	0.27
Cody	Nebraska	W	N	300	0.10
Crookston	Nebraska	W	N	270	0.04
Gordon	Nebraska	W	N	1,500	0.50
Hay Springs	Nebraska	W	N	750	0.15
Hemingford	Nebraska	W	N	700	0.10
Kilgore	Nebraska	W	N	-	-
Long Pine	Nebraska	SP	N	700	0.20
Lusk	Wyoming	W	N	1,800	0.75
Merriman	Nebraska	W	N	400	0.03
Royal	Nebraska	W	N	130	0.005
Rushville	Nebraska	W	N	1,000	0.10
Springview	Nebraska	W	N	330	0.032
Valentine	Nebraska	W	N	2,100	0.40
Wood Lake	Nebraska	W	N	320	0.135
	Total			11,950	2.812
Ponca Creek Valley					
Butte	Nebraska	W	N	360	0.036
Lynch	Nebraska	SP	N	400	0.040
Spencer	Nebraska	W, SP	N	600	0.040
Verdel	Nebraska	W	N	100	0.003
Bonesteel	South Dak.	W&Creek	N	520	0.025
Burke	South Dak.	W	N	600	0.060
Colome	South Dak.	W	N	460	0.020
Dallas	South Dak.	W	N	250	0.030
Fairfax	South Dak.	W	N	150	0.015
Gregory	South Dak.	W	D	1,300	0.060
Herrick	South Dak.	W	N	120	0.010
	Total			4,860	0.339

[1] Source - W - Wells
SP - Springs

[2] Treatment - N - None
D - Chlorinated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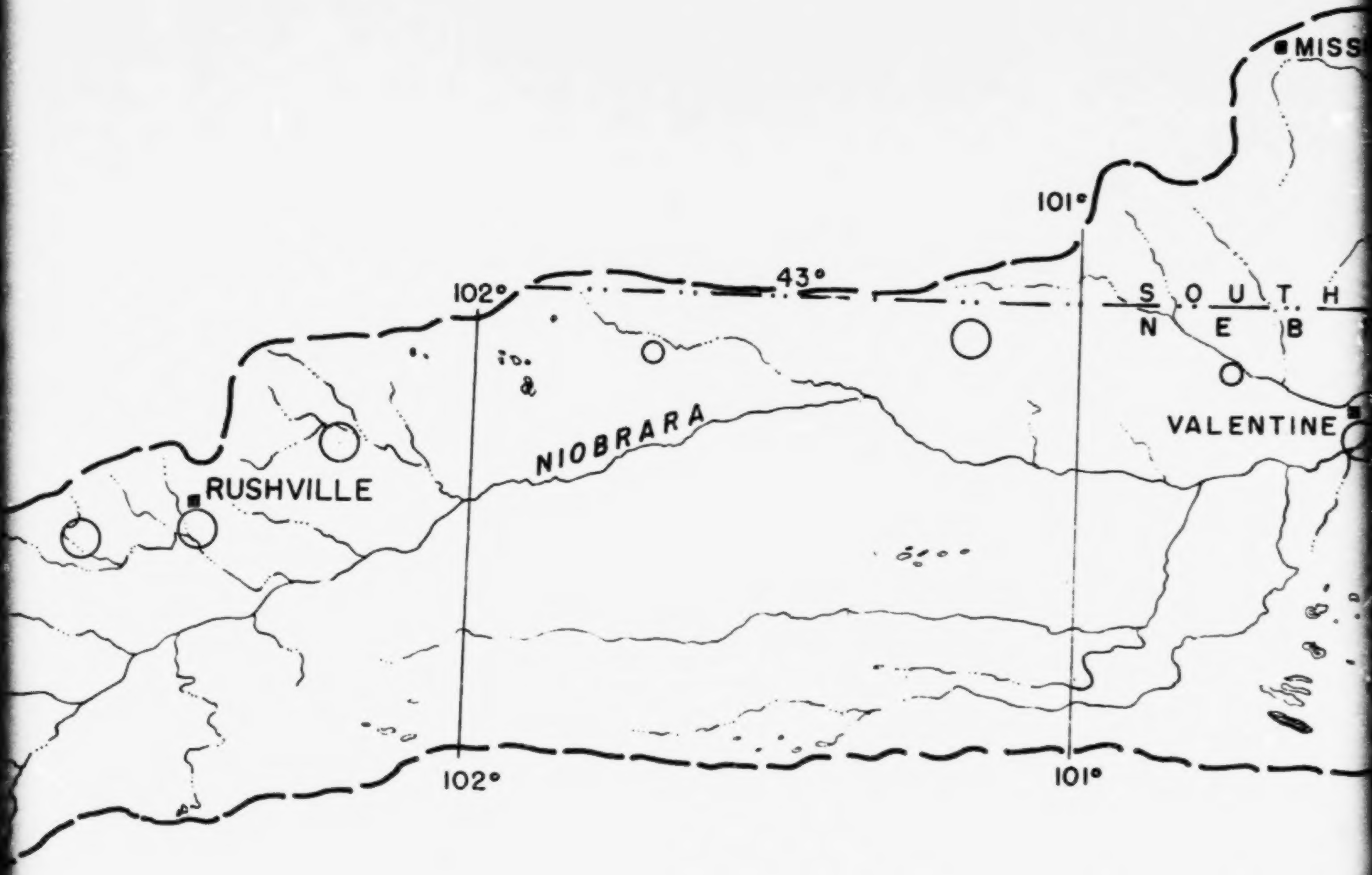
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RUSHVILLE
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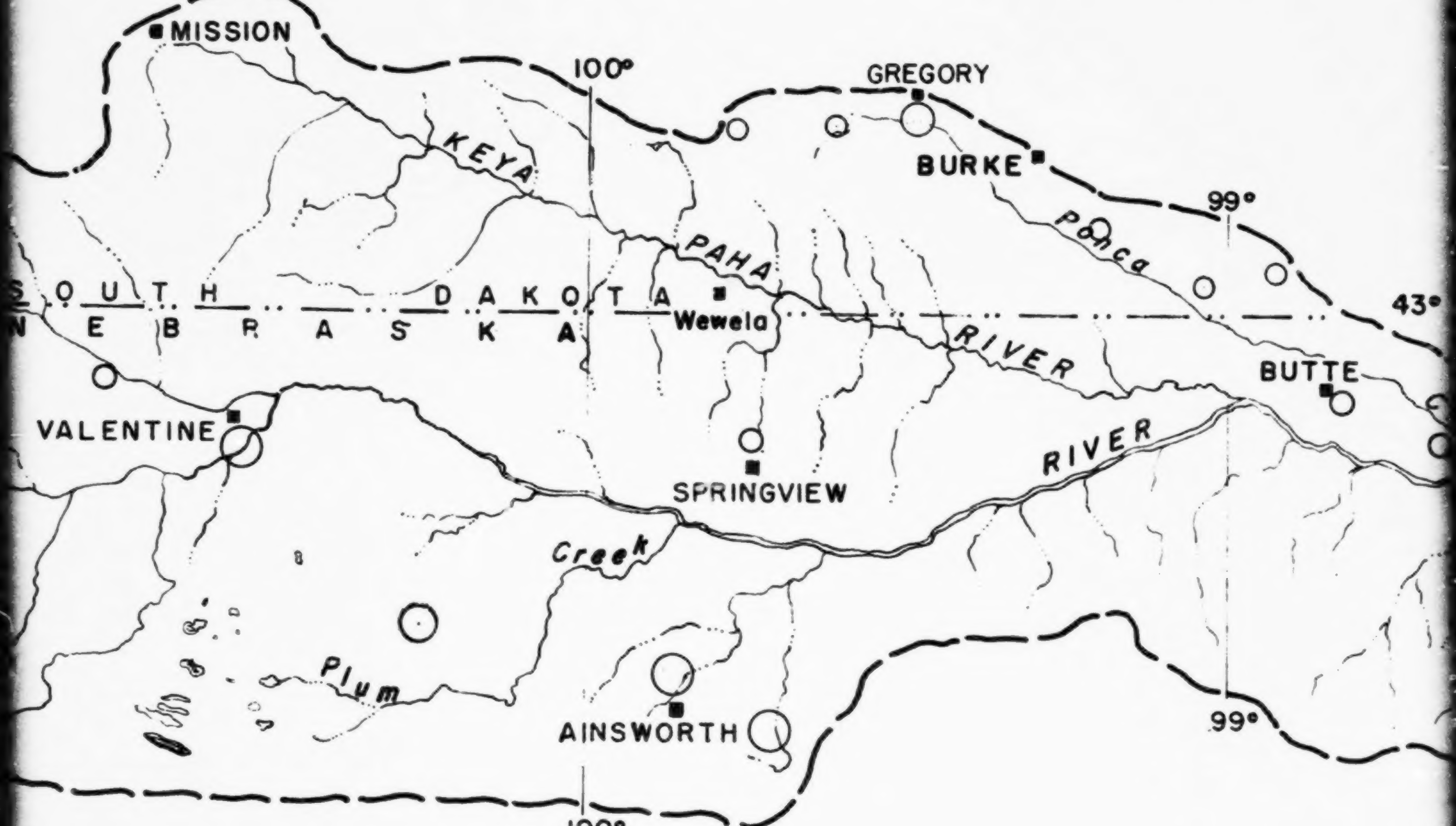
LEGEND

URFACE UPPLIES	UNDERGROUND SUPPLIES	QUANTITY GALLONS PER DAY
●	○	5,000 - 50,000
●	○	50,000 - 100,000
●	○	100,000 - 1,000,000

36-B


MISSION
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SPRINGVIEW
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Plum
AINSWORTH
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NIOBRARA RIVER BA

MUNICIPAL WATER SUPPL

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION C
JUNE 1949

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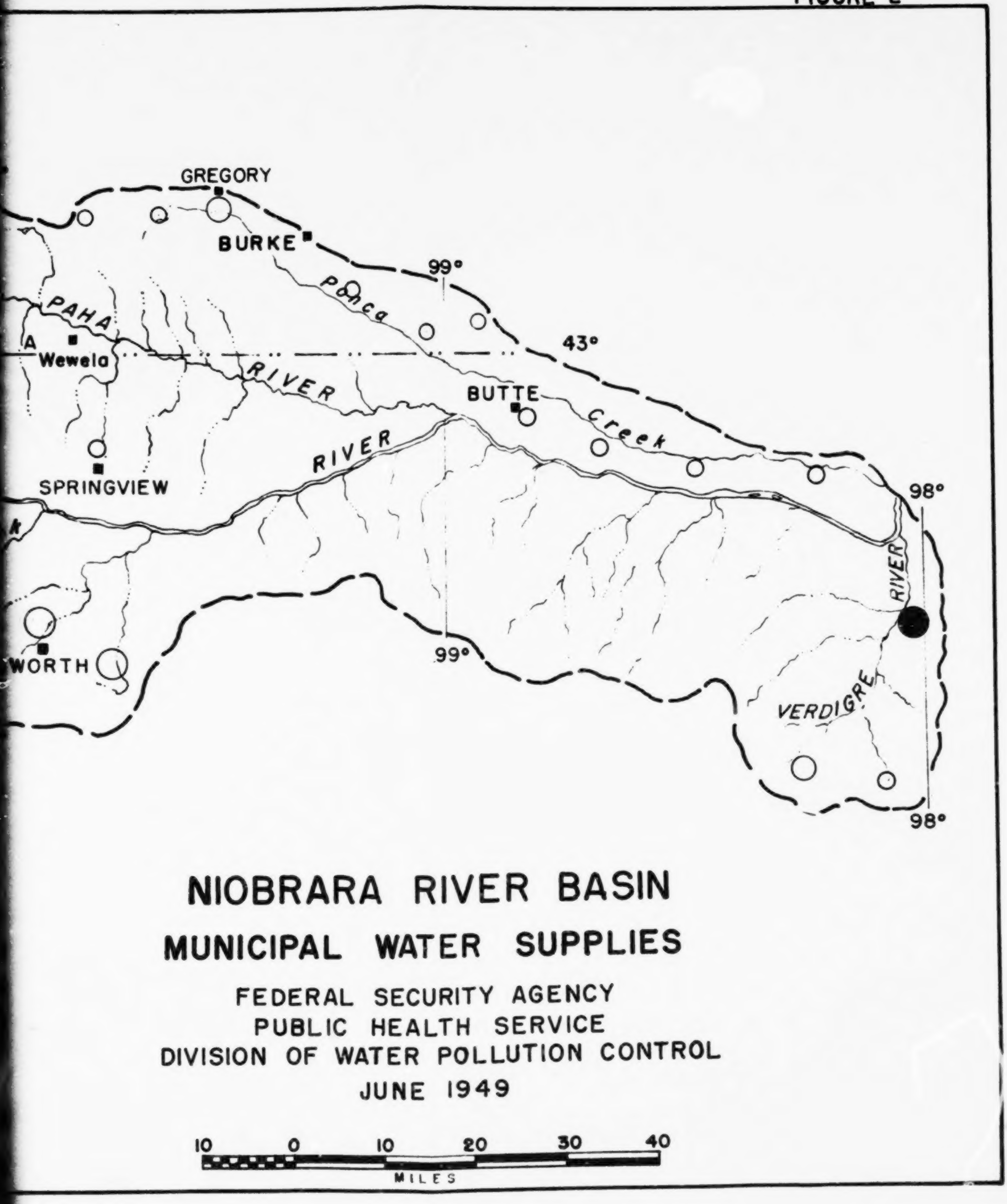
MILES

FIGURE 2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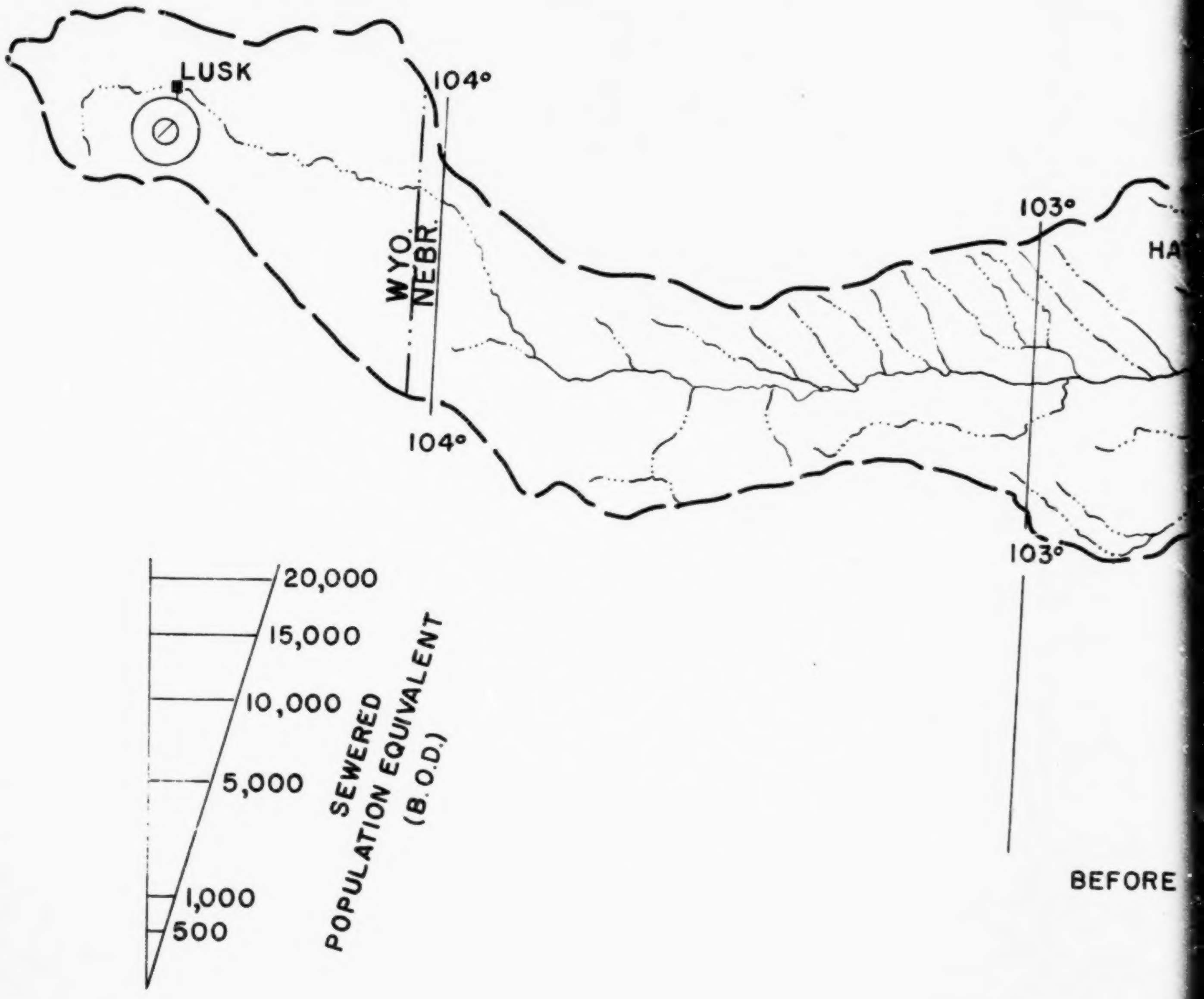
NIOBRARA RIVER BASIN
MUNICIPAL WATER SUPPLIES
FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL
JUNE 1949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(B.O.D.)
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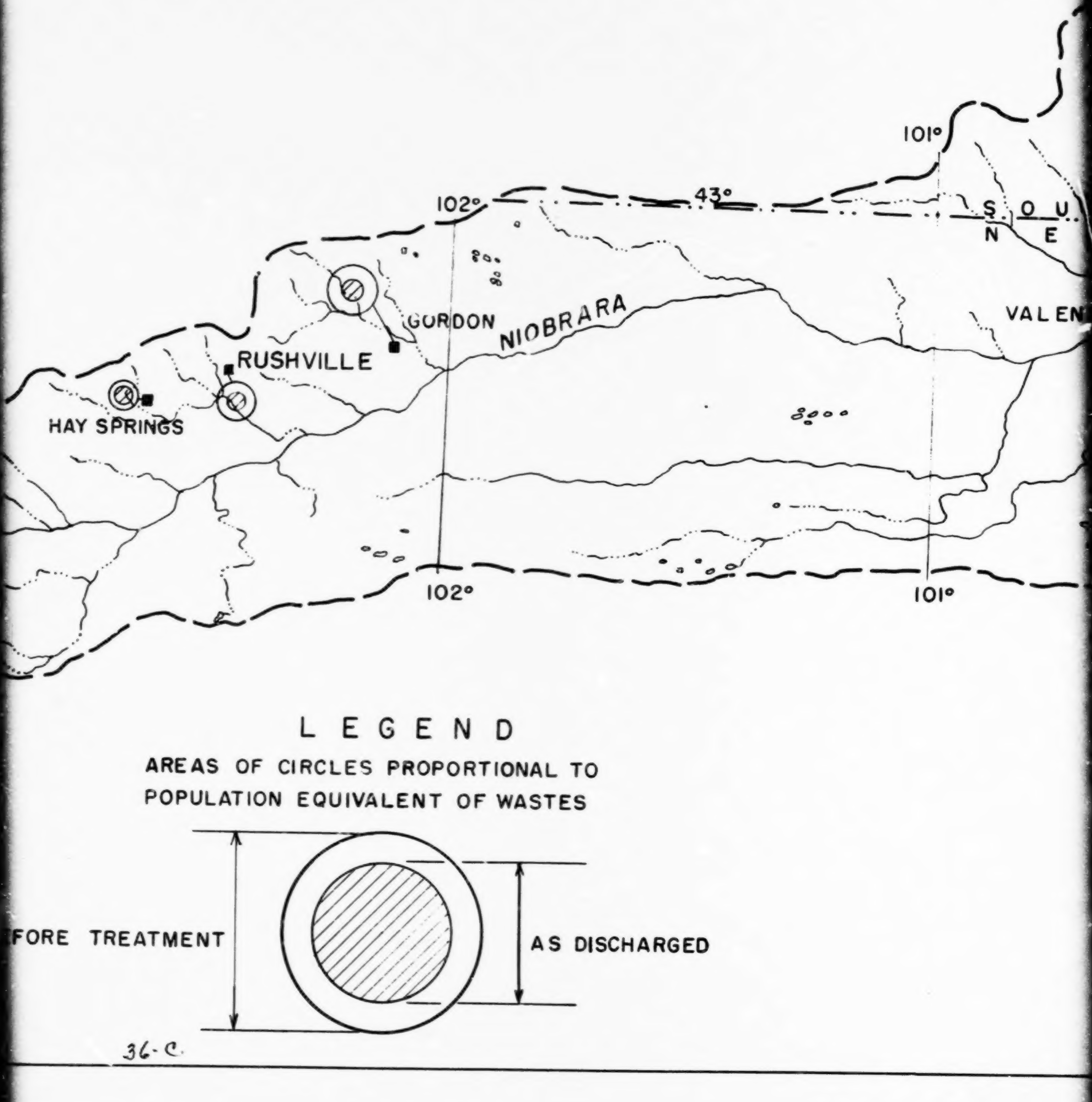
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VALEN
RUSHVILLE
HAY SPRINGS
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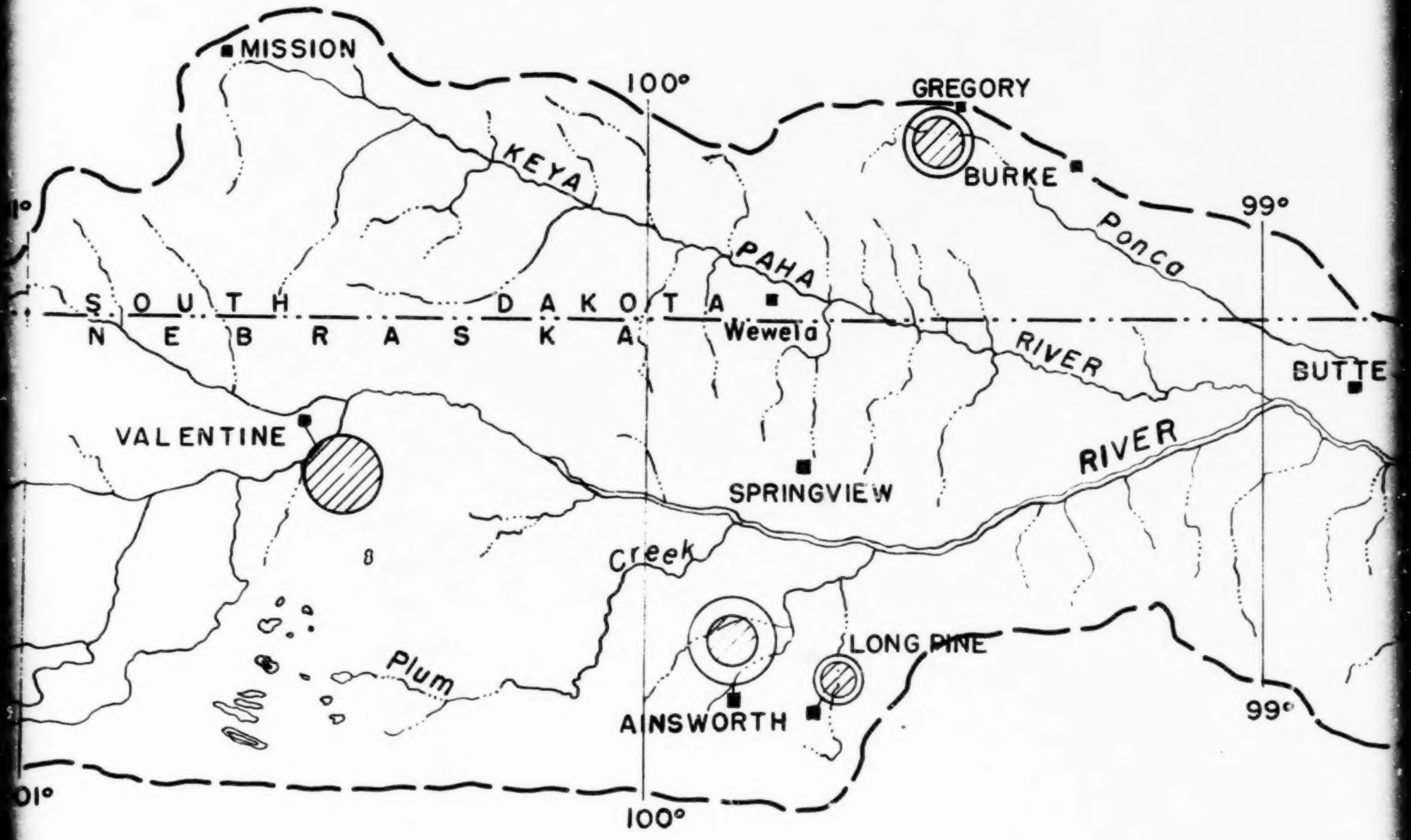
LEGEND
AREAS OF CIRCLES PROPORTIONAL TO
POPULATION EQUIVALENT OF WASTES
FORE TREATMENT
AS DISCHARGED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LONG PINE
AINSWORTH
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NIOBRARA RIVER

WATER POLLUTION INVES
JUNE 1949

SOURCES OF POLLU

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PUBLIC HEALTH SERV
DIVISION OF WATER POLLUTI

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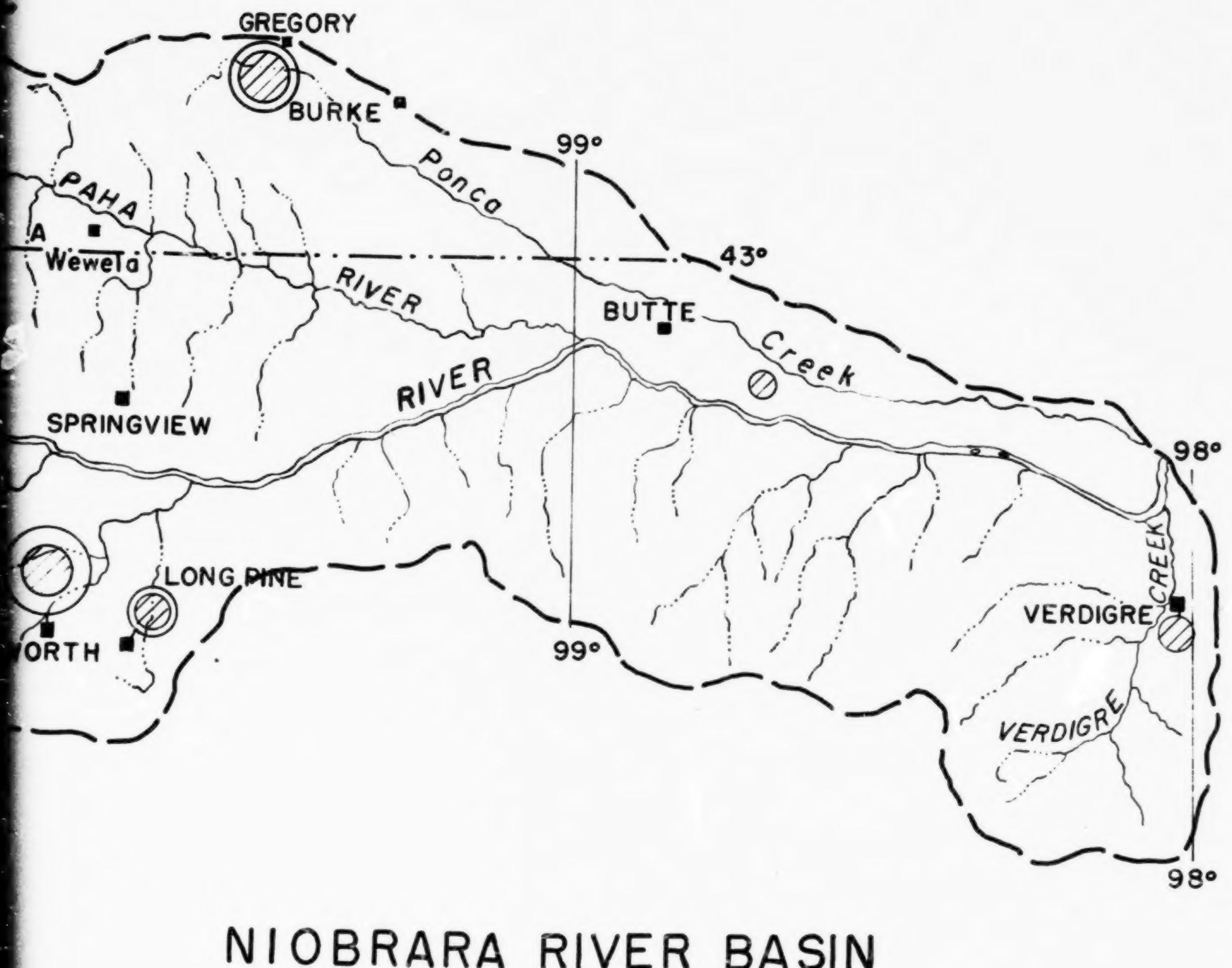
FIGURE 3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VERDIGRE
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VERDIGRE
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NIOBRARA RIVER BASIN

WATER POLLUTION INVESTIGATION
JUNE 1949

SOURCES OF POLLUTION

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL

10
0
10
20
30
40
MILES

Table 8. Sources of pollution including industrial wastes expressed as sewered population equivalent (B.O.D.)

Municipality	State	Miles above mouth Niobrara River	Miles above mouth Tributary	Population connected to sewers	Treatment[1]	Sewered population equivalent (B.O.D.) Untreated	Sewered population equivalent (B.O.D.) Discharged
Niobrara River Basin							
Niobrara River		0					
Verdigre Creek		5					
Verdigre	Nebraska		9	0	N	525*	525
Long Pine Creek		96					
Bone Creek			13				
Ainsworth	Nebraska		19	1,100	S	2,970	890
Long Pine	Nebraska		17	800	P	800	520
Minnechaduza Creek		146					
Valentine	Nebraska		4	2,000	N	2,160	2,160
Antelope Creek		241					
Gordon	Nebraska		12	1,500	S	1,500	450
Rush Creek		264					
Rushville	Nebraska		13	1,000	S	1,000	300
Hay Springs	Nebraska		17	600	P	600	300
Niobrara River							
Lusk	Wyoming	420		1,000	S	1,200	480
Total				8,000		10,755	5,625
Ponca Creek Valley							
Ponca Creek							
Gregory			75	1,185	P	1,185	880
Spencer			35	480	N	480	480
Total				1,665		1,665	1,360

[1] Treatment - N - None
P - Primary
S - Secondary

*Sewers serve only school and industry.

population equivalents untreated to Ponca Creek and Gregory, serving 1,185 people, reduces its waste by primary treatment to 880 population equivalents before discharge to a small creek.

Laboratory Results

Median coliform counts and average dissolved oxygen and biochemical oxygen demand data are presented in figures 4, 5 and 6. A summary of individual results is included as appendix C. The condition of the Niobrara River is reflected in the plotted data. Sources of pollution are not large and are separated by considerable distance. Dissolved oxygen values did not drop below 7.7 p.p.m. and the biochemical oxygen demand did not exceed 3.2 p.p.m., which is indicative of moderately light pollution. The median coliform count of 2,300 per 100 ml. below the confluence of Minnechadusa Creek and the Niobrara River substantiates the foregoing indication of light pollution. However, an increase in coliform count and B.O.D., accompanied by a decline in the dissolved oxygen concentration, indicates the effect of the pollutional wastes discharged by Valentine.

Data for tributary streams are also presented; these include the Keya Paha River and Verdigre Creek, Plum Creek, Long Pine Creek, Bone Creek, Bear Creek, Minnechadusa Creek and Ponca Creek. Dissolved oxygen values were consistently greater than 5.0 p.p.m., but were depressed by the discharge of sewage at Ainsworth and Valentine. Biochemical oxygen demand values were uniformly low with maximum values showing moderate pollution. Median coliform bacteria numbers varied considerably with maximum readings of 240,000 per 100 ml.

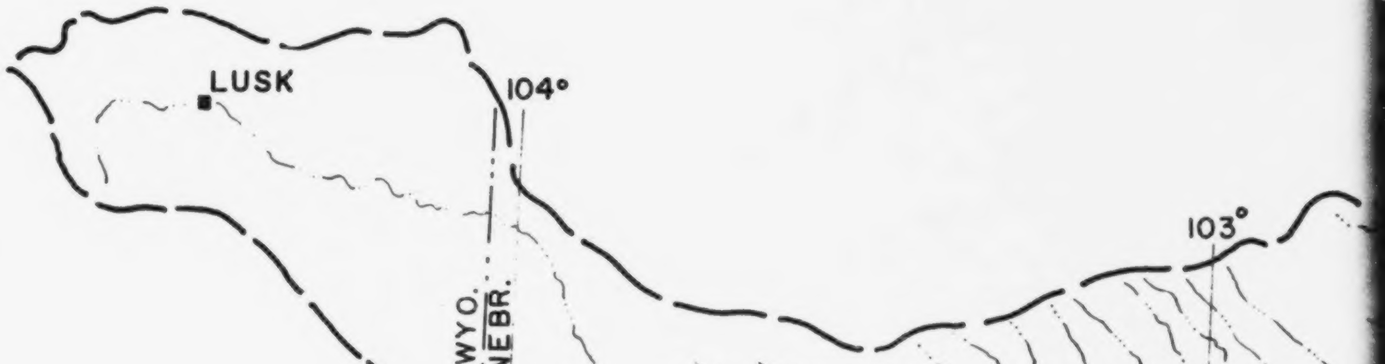
The effects of pollution entering tributary streams were minimized by exceptionally high flows experienced during the period of sampling. Flow data are presented in appendix C. Average flows at time of sampling were: 130 c.f.s. on Long Pine Creek; 119 c.f.s. on Plum Creek; 28 c.f.s. on Minnechadusa Creek; and 15 c.f.s. on Ponca Creek. Discharge of Bone Creek was estimated at 50 c.f.s. or about 10 times the mean flow.

Low Flow Frequencies

The results of flow studies are compiled in tables 9 and 10. One station records an 18-year gaging record, one six years, another three years, while four show 2-year records. It is noteworthy that records of the Niobrara River only are listed because of the dearth of information pertaining to tributary streams.

Observations by the Bureau of Reclamation indicate that approximately 0.1 c.f.s. is discharged for a period of 60 days by Ponca Creek.

Computation of the low mean monthly flow entailed the selection of the lowest monthly flow in the summer period June to September,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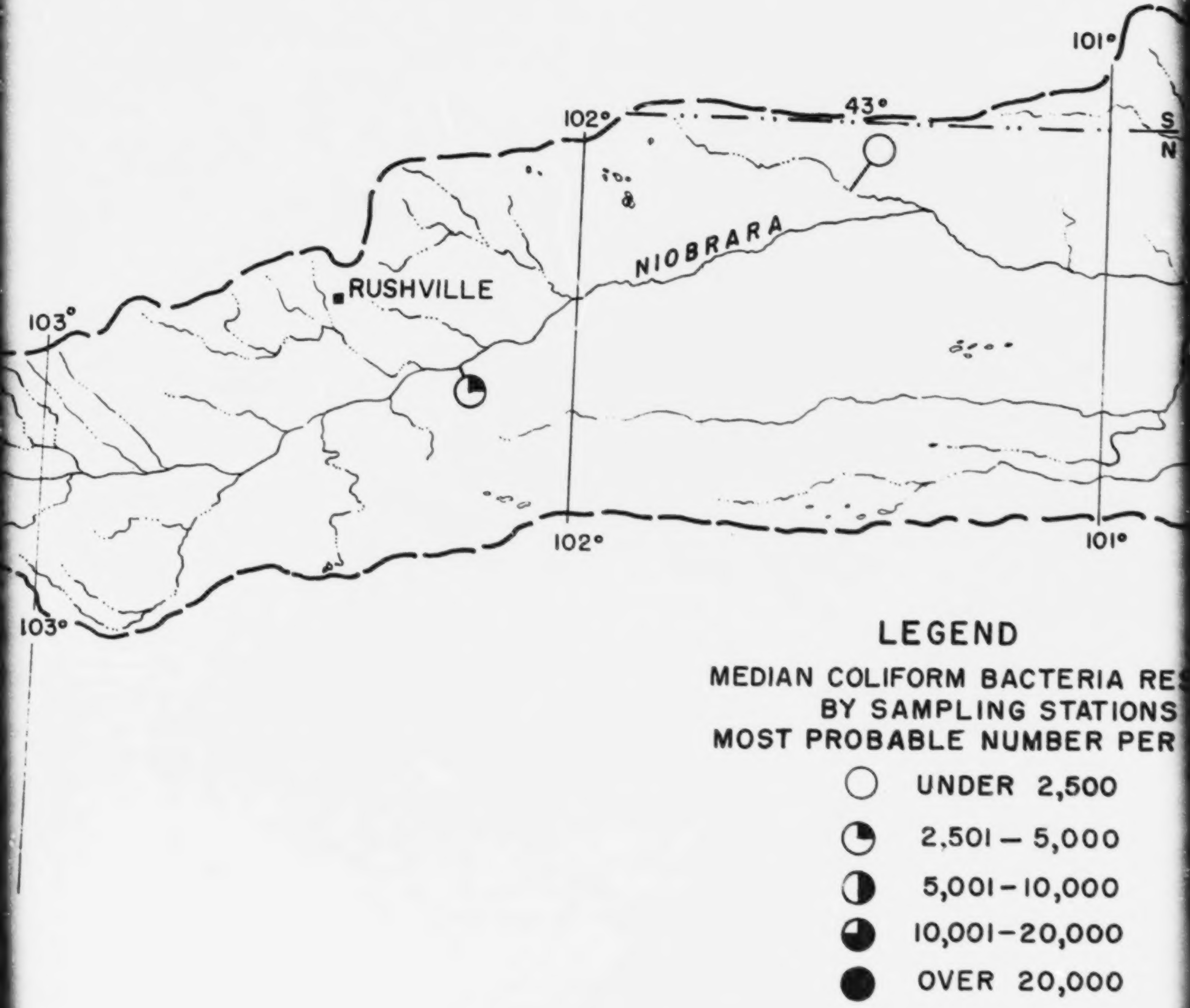
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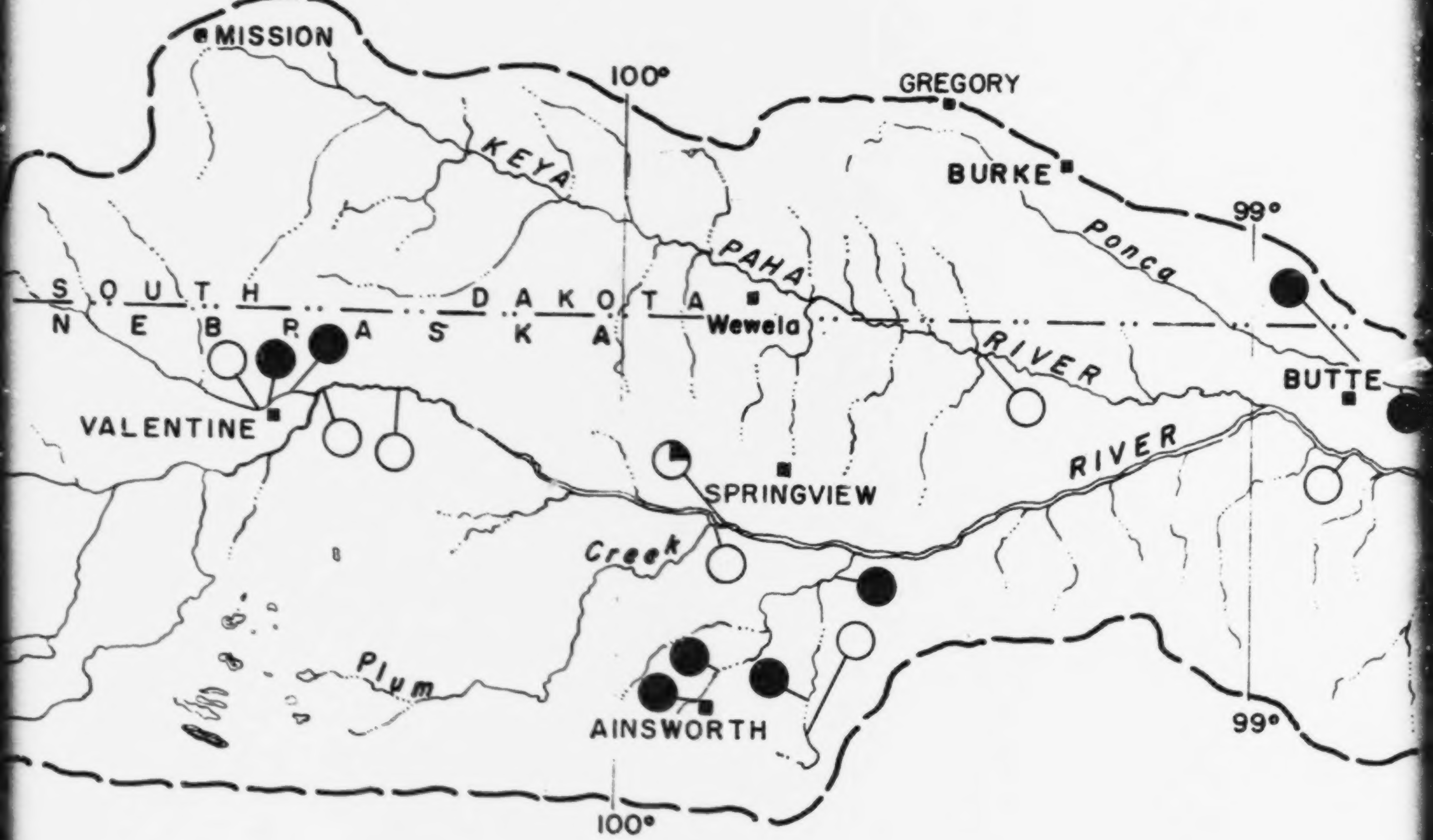
LEGEND
MEDIAN COLIFORM BACTERIA RES
BY SAMPLING STATIONS
MOST PROBABLE NUMBER PER
○ UNDER 2,500
◔ 2,501 – 5,000
◑ 5,001 – 10,000
◕ 10,001 – 20,000
● OVER 20,000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BUTTE
VALENTINE
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SPRINGVIEW
Creek
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AINSWORTH
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RESULTS
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ER 100 ML.

NIOBRARA RIVER
MEDIAN COLIFORM R

FEDERAL SECURITY AGE
PUBLIC HEALTH SERV
DIVISION OF WATER POLLUTIO
JUNE 1949

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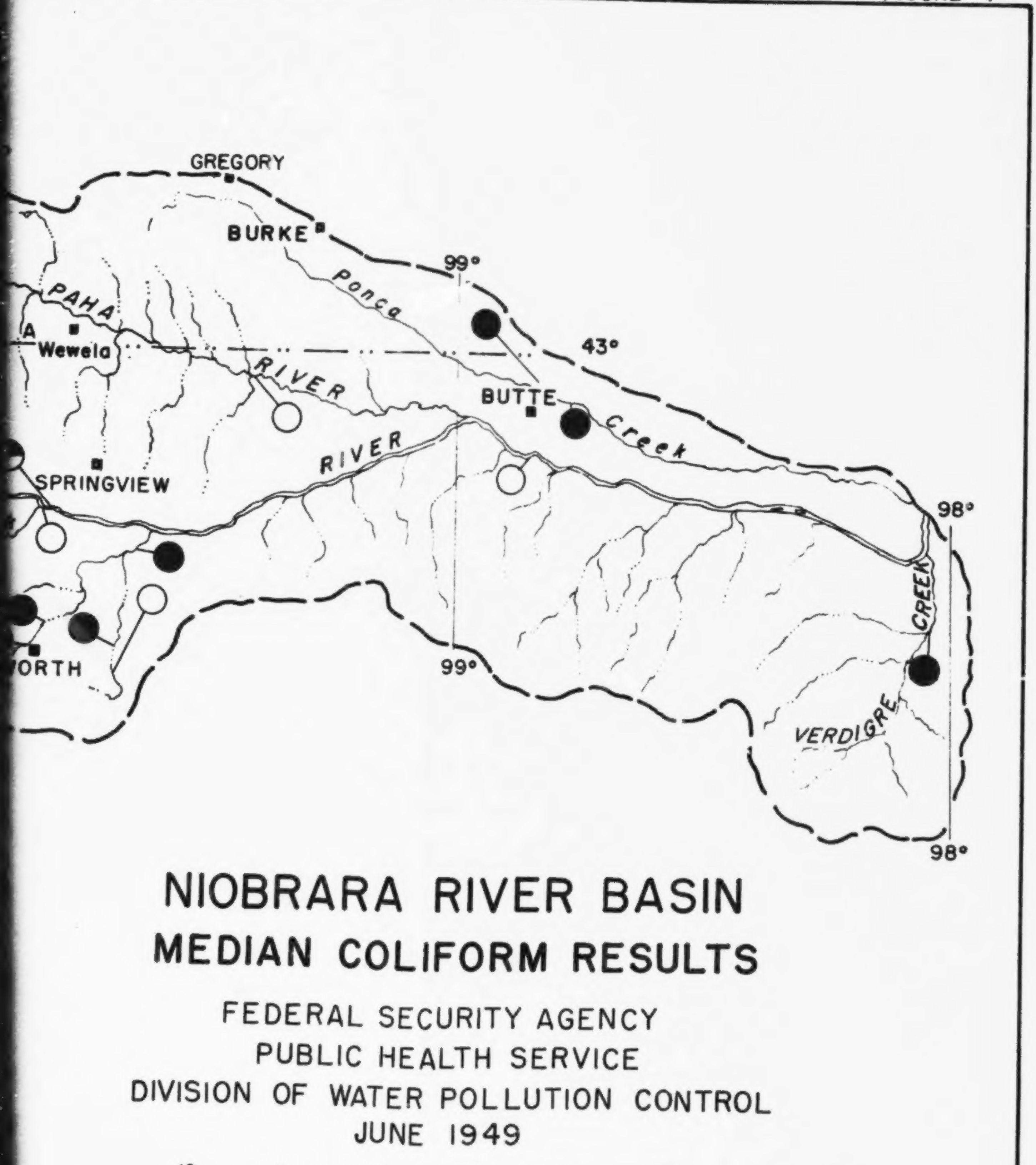
MILES

FIGURE 4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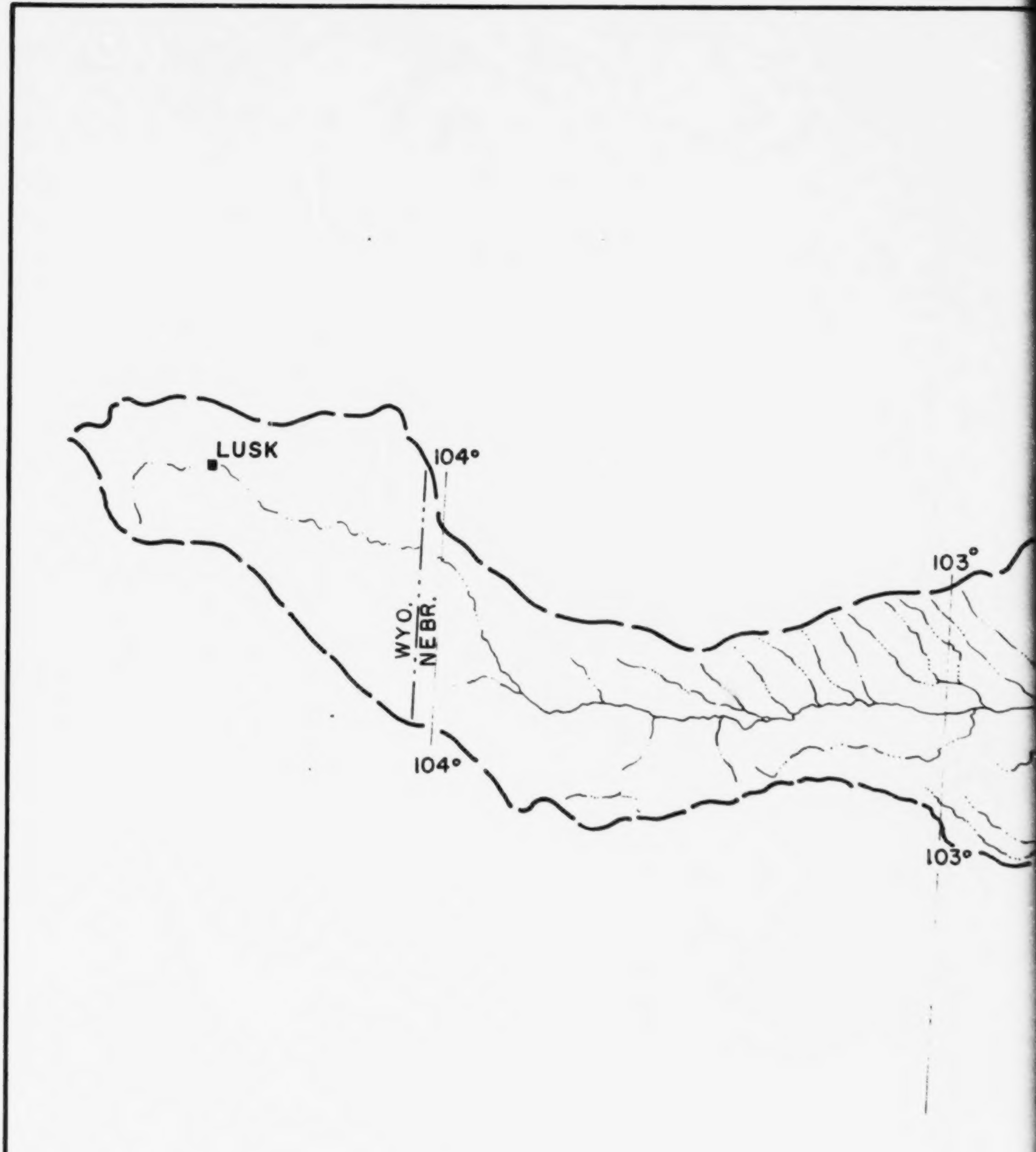
MILES

NIOBRARA RIVER BASIN
MEDIAN COLIFORM RESULTS

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL
JUNE 1949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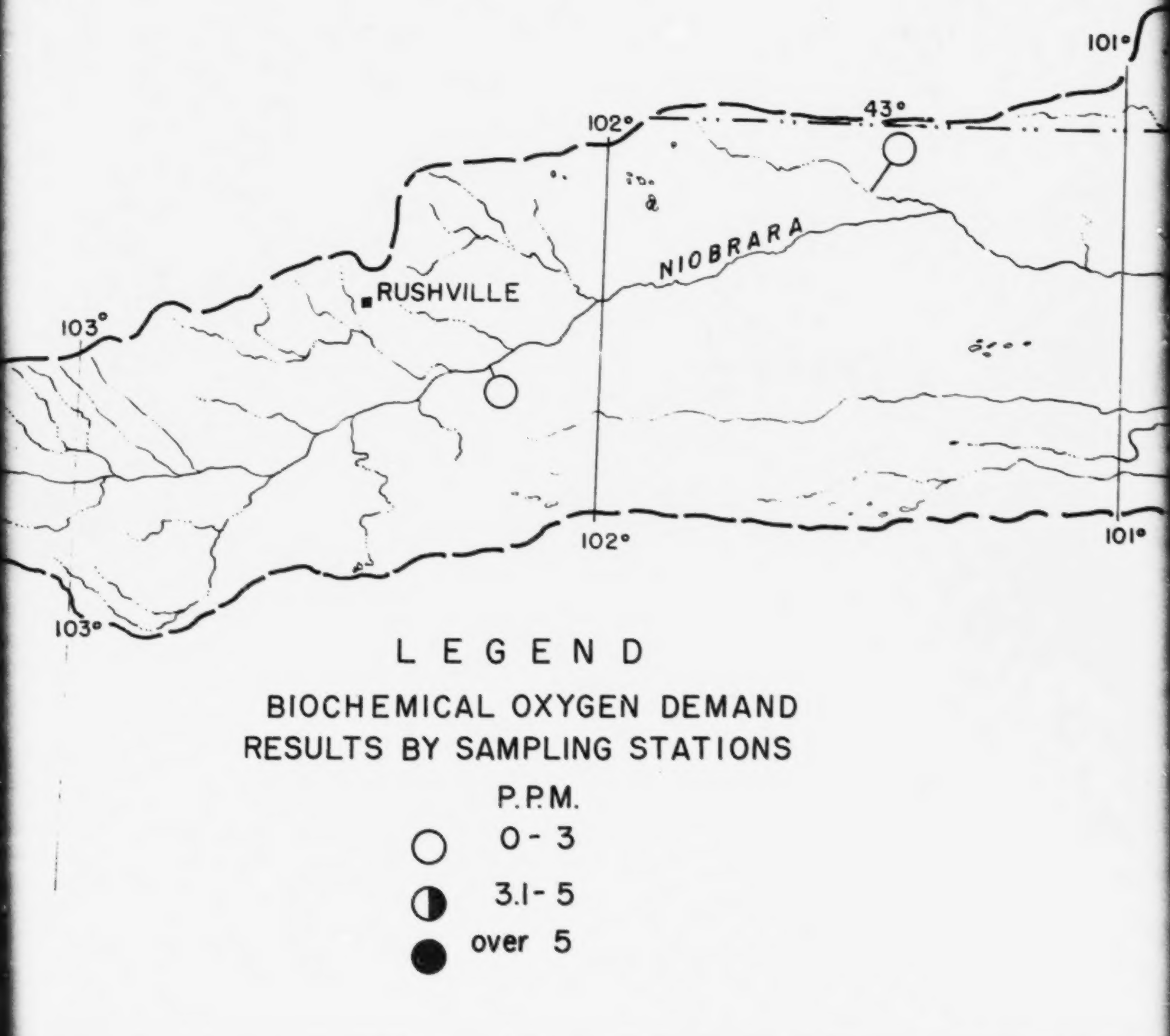
101°
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NIOBRARA
RUSHVILLE
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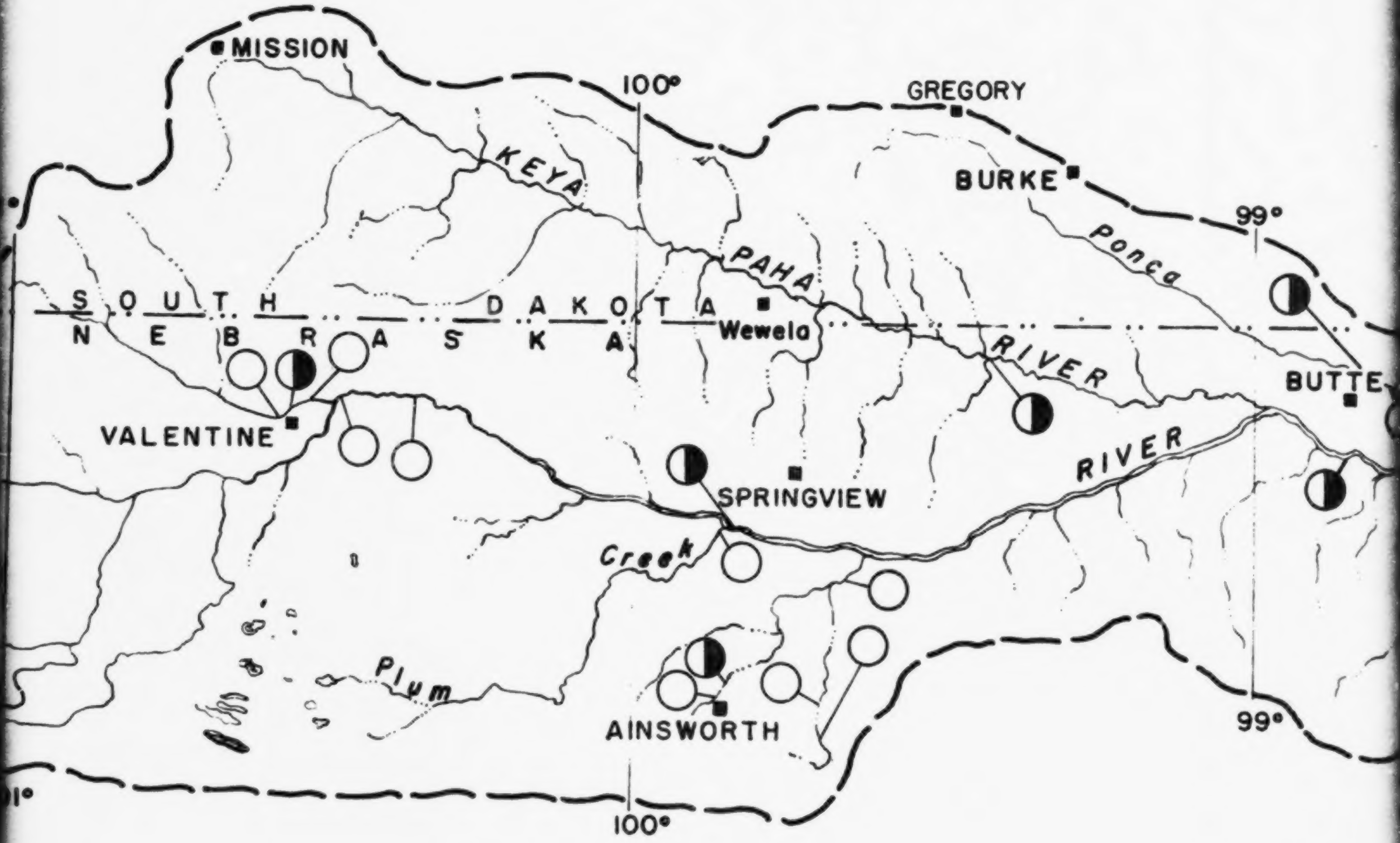
LEGEND
BIOCHEMICAL OXYGEN DEMAND
RESULTS BY SAMPLING STATIONS
P.P.M.
○ 0 - 3
◐ 3.1 - 5
● over 5


MISSION
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NIOBRARA RIVER B

BIOCHEMICAL OXYGEN D
AVERAGE RESULTS

FEDERAL SECURITY AGEN
PUBLIC HEALTH SERV
DIVISION OF WATER POLLUTION

JUNE 1949

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MILES

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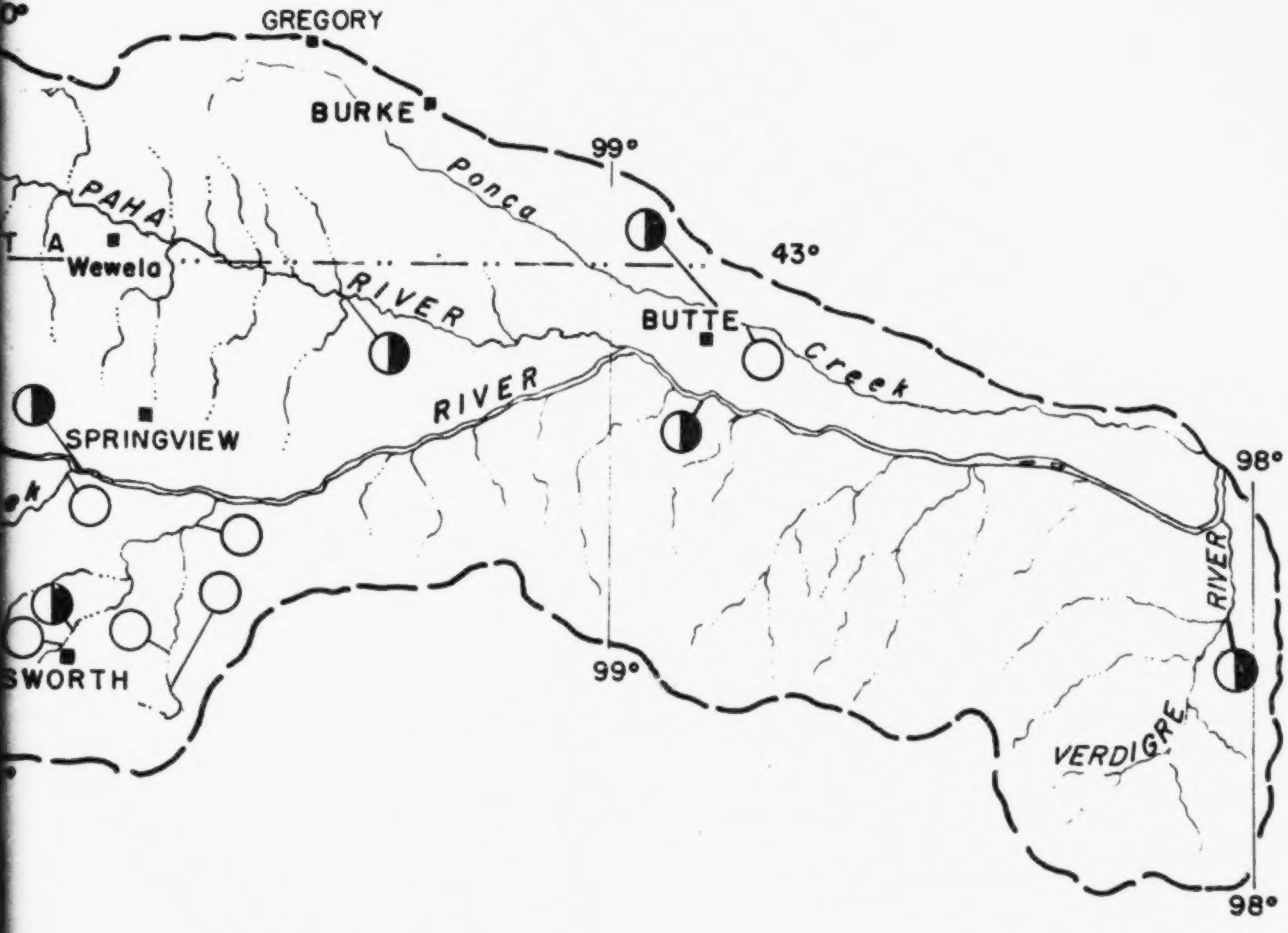
GREGORY
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BUTTE
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RIVER
99°
SWORTH
VERDIGRE
98°

NIOBRARA RIVER BASIN

BIOCHEMICAL OXYGEN DEMAND
AVERAGE RESULTS

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL

JUNE 1949

10
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30
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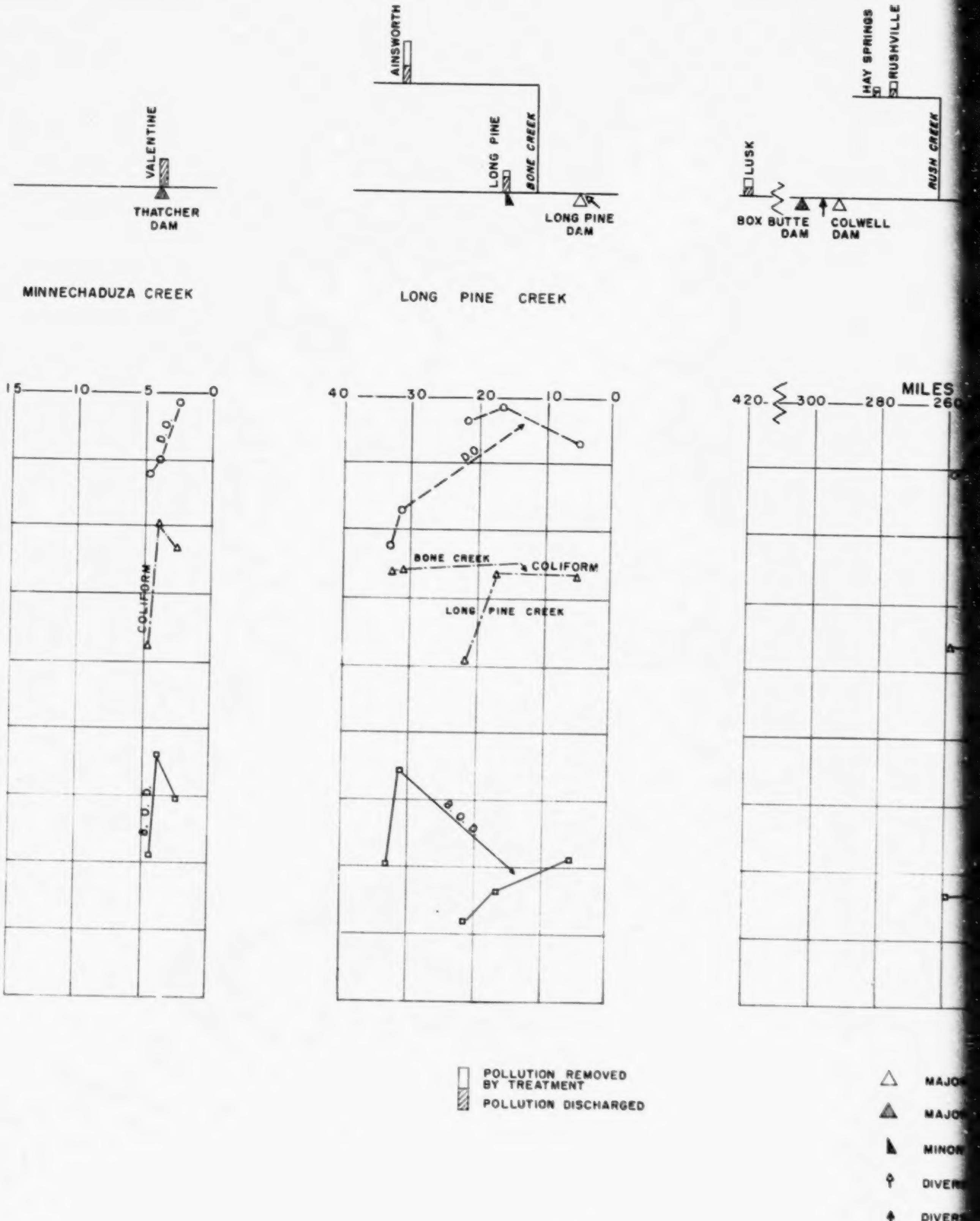
MILES


VALENTINE
THATCHER DAM
MINNECHADUZA CREEK
AINSWORTH
LONG PINE
BONE CREEK
LONG PINE DAM
LONG PINE CREEK
LUSK
BOX BUTTE DAM
COLWELL DAM
HAY SPRINGS
RUSHVILLE
RUSH CREEK
MILES
15
10
5
0
40
30
20
10
0
420
300
280
260
D.O.
COLIFORM
B.O.D.
BONE CREEK
COLIFORM
LONG PINE CREEK
D.O.
B.O.D.
POLLUTION REMOVED BY TREATMENT
POLLUTION DISCHARGED
MAJO
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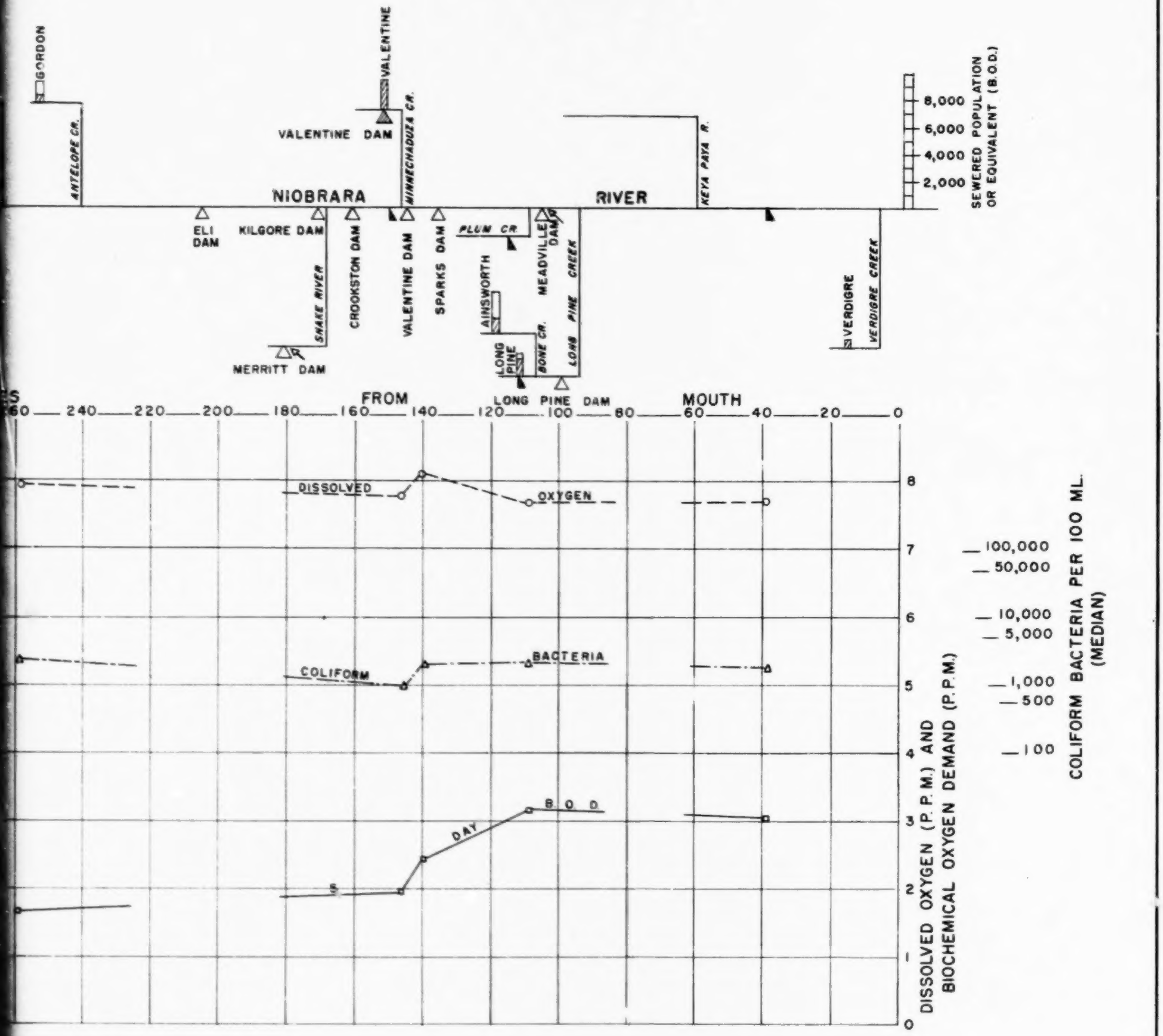
DIVER
DIVER

FIGURE 6



NIOBRARA RIVER BASIN

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL

JUNE 1949

Table 9. Frequency of low mean monthly summer (June - Sept) discharges

Years of Record	Stream and Location	Miles to Mouth Niobrara River	Minimum monthly mean flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum
	Niobrara River						
18	Spencer, Nebraska	38	840	810	790	560	440
3	Sparks, Nebraska	139	650	640	640	640	640
2	Near Cody, Nebraska	196	250	250	250	250	250
6	Near Gordon, Nebraska	260	87	85	82	77	77
2	Near Colclesser, Nebraska	273	39	39	39	39	39
2	Below Box Butte, Nebraska	306	35	25	22	22	22
2	Marsland, Nebraska	320	17	14	13	13	13

Table 10. Frequency of low mean monthly winter (Dec - Feb) discharges

Years of Record	Stream and Location	Miles to Mouth Niobrara River	Minimum monthly mean flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum
	Niobrara River						
17	Spencer, Nebraska	38	920	860	790	700	620
3	Sparks, Nebraska	139	730	720	710	710	710
2	Near Cody, Nebraska	196	320	320	320	320	320
6	Near Gordon, Nebraska	260	120	110	94	82	81
2	Near Colclesser, Nebraska	273	40	40	40	40	40
2	Below Box Butte, Nebraska	306	1	1	1	1	1
2	Marsland, Nebraska	320	44	44	44	44	44

inclusive, and the winter period December to February, inclusive. Low summer flows are of significance because of the concurrence of low stream discharges with the reduced dissolved oxygen content resulting from high stream temperatures and increased biological activity. Winter low flows are important, particularly when those flows are appreciably reduced by storage for irrigation. Also, streams prone to freezing may not become reoxygenated because of ice cover, thereby creating nuisance conditions below sources of pollution during the winter months unless stream discharge provides sufficient dilution water.

DISCUSSION

Municipal Water Supplies

Verdigre is the sole utilizer of a surface water supply. Water pumped from Verdigre Creek is sometimes chlorinated before distribution to consumers. The average B.O.D. at the water intake was 4.2 p.p.m., while the median coliform bacteria count was 24,000 per 100 ml. These results indicate that the waters are subjected to moderate pollution and should receive a higher degree of treatment before being distributed for consumption.

Generally, the Niobrara River Basin is fortuitously endowed with an ample ground water aquifer of good quality. With the exception of Verdigre and Hay Springs, all other communities draw upon this copious underground source which is utilized without treatment. Hay Springs secures its water from a separate aquifer and is having difficulty in securing an adequate supply, and since continued growth of any community depends largely upon an ample water supply, consideration of the use of a surface source of water is suggested as an alternative. Fortunately, Hay Springs is located near the Mirage Flats Irrigation Project, which uses Niobrara River water diverted at Dunlap Diversion Dam; and a portion of this water could be pumped to Hay Springs for a public water supply. However, it is to be noted that the Mirage Flats Project was not designed to provide municipal water supplies and water rights for the project are solely for irrigation. Advance planning for public water supplies would have been desirable in this case.

The development of a storage reservoir on Ponca Creek above Anoka, Nebraska, may result in a substantial elevation of the ground water and may alleviate the water problems now in existence at the towns located below the potential dam. Lynch and Spencer both suffer from an inadequate supply.

Anoka's water supply is obtained from a ground source, but because of the hardness of this supply resort is made to a supply obtained from private springs and made available to Anoka residents at a flat rate. An increase in ground water quantity might eventually affect a reduction of hardness and would present a tangible monetary benefit equivalent to or greater than costs of the imported water bought for domestic use.

An estimated capital monetary benefit of $100 per capita will accrue to the development program should a satisfactory water supply be provided to the communities of Anoka, Lynch, Spencer and Verdel as a result of water conservation. Estimating interest at 4 percent and assuming a life of 20 years for amortization, the annual benefit per capita would be approximately $7.35.

Irrigation Water Quality

The fact that irrigation water may contain sewage, raw and/or treated, is of significance. The public health importance of contaminated waters used to irrigate truck crops which generally are eaten raw should not be overlooked. If the effluent from any sewage plant is discharged into a stream that is used for irrigating truck crops which are generally eaten raw, the effluent should be chlorinated prior to its disposal.

Sources of Pollution and Status of Sewage Treatment

Sources of pollution are neither large nor many in number, reflecting the sparsely settled, rural characteristics of the Basin. A greater part of the wastes discharged to the streams is domestic. Industrial wastes from a few small establishments are usually discharged through municipal sewers. Valentine, Nebraska, located on Minnechaduza Creek, and Verdigre, Nebraska, located on Verdigre Creek, emit sewage untreated. Lusk, Wyoming; Rushville, Nebraska on Rush Creek; and Gordon, Nebraska on Antelope Creek, provide secondary treatment. Ainsworth, Nebraska on Bone Creek, uses intermediate treatment facilities. Hay Springs, Nebraska on Rush Creek, and Long Pine, Nebraska on Long Pine Creek, have primary treatment plants. Gregory, South Dakota, discharges its Imhoff tank effluent to a small tributary of Ponca Creek. Spencer, Nebraska, does not possess any treatment facilities at the present time.

Stream Conditions and Sewage Treatment Needs

It is assumed critical pollution conditions will be corrected by State action. It is in the States' interest to maintain optimum stream conditions to protect the public health and to prevent nuisance conditions. These conditions can be alleviated by the installation of treatment plants designed to relieve the pollutional load discharged to the stream. The treatment required will depend upon the nature and site of the contributed wastes and upon the flow conditions encountered. Primary treatment for the removal of settleable solids and floating matter is regarded as a minimum requirement. Desirable minimum stream flows are those flows required for the dilution of primary treatment plant effluent so as to maintain a minimum of 5 p.p.m. dissolved oxygen for balanced aquatic life. When normal minimum flows are below the limit required for the dilution of primary treatment effluent secondary treatment is necessary. Normal minimum flows may be defined as that mean monthly flow occurring at such a frequency as to form a firm basis for sewage treatment design. It is generally taken as the minimum mean monthly flow to be expected to occur once in five or ten years, depending upon stream conditions encountered. Secondary treatment desirable flows have been calculated on the assumption that sewage and industrial wastes receive secondary treatment and therefore need less dilution for the assimilation of the residual pollution.

The degree of sewage treatment required is based upon normal low flow expectancies and downstream water use. Critical conditions may be anticipated where stream discharges provide insufficient dilution. Pollution problems in the Niobrara River Basin as indicated by the presence of high coliform counts become manifest on the tributary streams during high temperature periods, June-September, inclusive. During this period the effects of reoxygenation are also minimized and sources of man-made pollution become a major factor in the determination of treatment requirements at critical flows. Estimates of sewage treatment requirements have been based upon minimum flow conditions. Greater stream flow is generally required in periods of high temperature than at times when the water temperature is low. Table 11 indicates a typical month-to-month variation in flow needs, with June, July, August and September representing 100 percent flows. The present evaluation is founded upon conditions observed during the pollution investigations coupled with analyses of available discharge records. It does not reflect a possible increase or decrease in minimum flow resulting from the development program.

The following communities require a higher degree of treatment than that provided at present: Lusk, Wyoming and Gregory, South Dakota; Gordon, Hay Springs and Rushville, Nebraska, need additional treatment plant capacity. The waste discharged by the school and industry at Verdigre should receive a minimum of primary treatment. Secondary treatment is recommended at Spencer, Nebraska.

The City of Valentine, Nebraska, discharges untreated wastes to Minnechaduza Creek. Formerly, the outfall extended to a point below a diversion structure which directs water to the State Fish Hatchery. A break in the sewer outfall developed and now the waste discharges to a ditch formed by the flow of sewage. The ditch enters Minnechaduza Creek a short distance below the hydroelectric power installation in the Valentine City Park.

Minnechaduza Creek is a regulated stream by virtue of the discharge which emanates from the tailrace of the power installation. In order to develop sufficient operating head the flow is at times reduced for a period of about one day to 5 second feet. The latter discharge represents the minimum flow necessary to cool equipment.

Table 11. Average temperatures and seasonal variations of desirable minimum monthly mean flows

Month	Approximate average stream temperature[1] °F	°C	Average air temperature[2] °F	°C	Minimum monthly mean flow as percent of summer season flow[1]
January	34	1	23	-5	20
February	34	1	26	-3	20
March	37	3	36	2	25
April	54	12	49	10	40
May	66	19	59	15	60
June	72	22	69	20	100
July	81	27	75	24	100
August	79	26	73	23	100
September	75	24	64	18	100
October	59	15	51	11	45
November	48	9	37	3	30
December	36	2	27	-3	20

[1] From report of Kansas River Basin Water Pollution Investigation June 1949.

[2] Average temperatures for State of Nebraska - 73 year record, U. S. Weather Bureau.

Valentine, Nebraska, should provide a minimum of primary treatment and should carefully consider the site of its disposal plant and the location of the outfall sewer. The latter recommendation is emphasized because of a favorable geological site, located about three-fourths of a mile below the confluence of the Minnechaduza Creek and the Niobrara River, for the construction of a reservoir dam. Completion of this structure would cause backwater to have a pooling effect on Minnechaduza Creek and may cause local nuisance at point of waste discharge unless a high degree of sewage treatment is provided.

Continued development of pump irrigation in the vicinity of Ainsworth may lower the ground water table and reduce discharges of Bone Creek which are normally 4 to 5 second-feet, and which were about 50 c.f.s. during the survey period. In this case, Ainsworth may be faced with the possibility of extending its present intermediate type of chemical precipitation plant to a higher degree of treatment. Over development of pump irrigation therefore may cause a monetary damage to the City of Ainsworth.

Table 12 presents a review of the status of disposal plants with requirements and recommendations.

Table 12. Sewage treatment requirements and recommendations

Municipality	State	Remarks	Status[1]
Niobrara River Basin			
Lusk	Wyoming	Higher degree of treatment required	3
Hay Springs	Nebraska	Expand present plant	1
Rushville	Nebraska	Expand present plant	3
Gordon	Nebraska	Expand present plant	1
Valentine	Nebraska	Plant required	2
Long Pine	Nebraska	Plant adequate	1
Ainsworth	Nebraska	Plant adequate	1
Verdigre	Nebraska	Plant required	2
Ponca Creek Valley			
Gregory	So.Dakota	Higher degree of treatment required	3
Spencer	Nebraska	Plant required	2

[1] Status: 1. Control or plant satisfactory
2. Project needed, no program known
3. Status not definitely known

Flow Needs: Benefits and Damages

The development program may provide increased minimum flows sufficient to permit a lower degree of sewage treatment which would produce tangible monetary benefits attributable to the reservoir regulating this flow. Contrariwise, damages may result if flows are reduced beyond the required minimum by water diversion to other uses. In this connection, it may not be assumed that pollution damage will not be suffered if regulation provides the minimum flow at a value about equal to the unregulated minimum previously prevailing. Stream conditions would be equal to those existing during unregulated minimums, and would be worse during the time regulated discharges are less than those that would naturally occur.

Refinement beyond primary treatment represents a substantial financial investment. Possible benefits may accrue where flow can be increased to permit satisfactory stream conditions with primary treatment only, thereby effecting sizable savings in initial plant costs as well as operation, maintenance and replacement. This saving is considered a direct benefit from the increase in stream discharge. Benefits have been assigned a monetary value based upon the differential of estimated annual costs of primary and secondary treatment amortized for 20 years at 4 percent interest plus maintenance and operation.

Damages or benefits are possible at Ainsworth, Nebraska, depending upon the continued development of pump irrigation methods which may deplete existing stream flows or a change to gravity irrigation which may add to present flows. A minimum flow of 6 c.f.s. in Bone Creek below Ainsworth would provide a benefit (table 13). Return water may also influence this situation. At Valentine, damages are possible depending upon the conditions set up by the backwater caused by the reservoir development below Valentine.

In the Ponca Creek Valley it is suggested that a minimum sustained flow of 2 c.f.s. be maintained at Spencer, Nebraska. An annual monetary benefit of $800 would then be accredited to the reservoir and appurtenances making this flow possible.

Table 13. Flow needs and cost evaluation

Community	Stream	Approximate Miles from Mouth Niobrara River	Tributary	Normal Minimum Flow[a]	Useful Desirable Minimum	Secondary Treatment Desirable Flows	Necessary to Prevent Damage to City	Annual Tangible Monetary Benefits Possible if Flow in Column 6 Provided
1	2	3	4	5	6	7	8	9
Niobrara River Basin Niobrara River								
Valentine, Nebr.	Minnechaduza Creek	146	4	18*	9	3	9	$ 0
Long Pine, Nebr.	Long Pine Cr.	96	17	10*	7	3	7	0
Ainsworth, Nebr.	Bone Creek	96	13	4*	6	6	6	$ 350**
	Via Long Pine Creek		17					
Verdigre, Nebr.	Verdigre Creek	5	9	47*	2	1	2	0
Ponca Creek Valley Ponca Creek								
Spencer, Nebr.	Ponca Creek	35		0.1	2	1	2	$ 800

*Unpublished data from Bureau of Reclamation.

**If pump irrigation depletes stream flow below 4 c.f.s. (column 5), a damage is possible.

[a] Minimum flows occurring at such frequency as to form a firm basis for sewage treatment design (see text).

APPENDIXES

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APPENDIX A

SUGGESTED STATE WATER POLLUTION CONTROL ACT*

EXPLANATORY STATEMENT

Increasing interest in development and conservation of our country's water resources has been reflected in the concern which legislatures have shown with the problem of water pollution. Within the last decade more than half the States have adopted new legislation in this field or strengthened existing laws, and in 1948 the Congress passed the Water Pollution Control Act, the first attempt by the Federal Government to join with the States in a comprehensive attack on the problem as a whole. A "Suggested State Water Pollution Control Act" has been prepared as a part of this effort.

The underlying concept and purpose of this legislation is to facilitate interstate cooperation for a more concerted attack on water pollution. Many benefits would be derived if the States adopted legislation uniform in basic principles. It is not expected that the States will repeal their existing legislation and adopt this suggested law. The process of obtaining uniformity is one of evolution. It is suggested that the States take a realistic look at their basic statutes in the field of water pollution control and compare them with the suggested law. Those familiar with State law in this field will find little that is new in the suggested draft. Basically, what has been done has been to adopt the best practices from existing State statutes and using these as a framework to develop a statute that could aid and strengthen the State programs.

A preliminary draft of the "Suggested Act" was submitted for comment to a large number of State sanitary engineers; lawyers; conservationists; industrialists; sportsmen's, wildlife and conservation, agricultural and recreational groups; national lay organizations; municipal organizations; and other persons interested in this field. Subsequently, the preliminary draft, together with comment which was received from all parts of the country, was considered and discussed by a board of expert consultants meeting in Washington. The "Suggested Act" was prepared and revised in light of comments and suggestions resulting from the foregoing procedures.

State water pollution control legislation developed traditionally out of the authority of health departments to preserve public health.

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* Prepared by Division of Water Pollution Control, Public Health Service, Federal Security Agency, Oct. 1950.

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In conjunction with this there was piecemeal lodging of concurrent water pollution control authority in several other departments of State governments such as those dealing with agriculture, fish and wildlife, and mines and minerals which also had an interest in water pollution control. The modern approach to the problem is reflected in recent State statutes whose object is to preserve and improve water quality for all legitimate uses and do this through an agency that represents all affected interests in the State. Accompanying this has been a shifting emphasis from the mere abatement of existing pollution to the policy of preventing pollution in its incipiency.

In the early statutes the administrative approach was largely negative in character. That is, when a particular action was found to cause pollution the administrative agency was authorized to take steps to abate such pollution. The Suggested State Water Pollution Control Act follows the more recent statutes by authorizing the agency to develop a comprehensive program to deal with the problem in all waters of the State. Under this approach, the agency, having determined permissive limits of waste discharges into the waters of the State, uses its enforcement procedure to abate existing pollution and restore the quality of polluted waters, while through a system of permits it prevents any increase in waste discharges which would impair desired water uses.

The Act is designed to give the agency broad discretion in administration of the program and makes its jurisdiction complete over all waters of the State. It avoids such restrictive practices as exemption of particular industries or geographic areas and legislative classification of particular streams for specified water uses.

While the Act is complete in itself, it rests on a framework of other State statutory and constitutional provisions. Perhaps one of the most important of these relates to municipal financing. No water pollution control program can operate successfully unless the State and its political subdivisions can finance the construction and operation of remedial works for treatment of wastes. The Suggested State Water Pollution Control Act does not treat this subject in view of its complexity and the numerous individual problems peculiar to particular States. Reference is made to the Council of State Government's 1949 program of suggested State legislation for a general approach to the problem and suggestions for individual States.

While a section-by-section analysis of the Act will not be attempted, some comments may be directed to its principal features.

Pollution. The most important definition in the Act is the definition of "pollution," which is designed to protect all legitimate uses of waters of the State. To this end, "pollution" as defined includes both discharges of wastes actually or potentially harmful to such uses and also altering the properties of the waters in such a way as to be harmful. The latter, for example, would cover heating of water in such a way as to deplete oxygen supply and reduce the capacity of the water to support fish life or stabilize discharges of wastes. This definition must be read together with subsequent sections of the Act authorizing the classification of waters and the setting of standards of water quality. Discharges which violate such standards and classifications are declared unlawful, but discharges consistent with them are not considered "pollution" for purposes of the Act. The Act, therefore, gives effect to the agency's action in classifying waters and setting standards but does not hold its enforcement powers in abeyance until such action can be completed.

Type of Administrative Agency. One of the most important questions for any State to decide in preparing water pollution control legislation is the agency to which enforcement of the program will be entrusted. As has been said, most early legislation of this type vested authority in the State health department. The problems of water pollution control, however, concern other interests than health, and in a broader sense are an integral part of the problem of preserving the water resources of the State. For example, wildlife and conservation interests, industry, municipalities and agriculture have a stake in the enforcement of a water pollution control program. It is believed important that any agency which is set up to administer such a program should be so constituted as to take into account the interests and views of these and other affected groups in addition to health considerations.

Most States which have recently enacted water pollution control legislation have entrusted its enforcement to a board representative of the interests considered to be affected. Such boards are sometimes made up of representatives of various departments of the State government, sometimes of citizens from outside the government, and more frequently of a combination of the two. Adoption of this form has the advantage of facilitating representation of affected interests in the agency. If it is adopted, provision should also be made for an executive secretary to serve as the administrator of the program and to carry out the policies adopted by the board. Some States may wish to vest responsibility for the program in a single administrator. If this is done, it would seem advisable to secure representation of affected interests through an advisory council, and it may also be considered desirable to set up a board of review to hear appeals from the single administrator's decisions.

The Suggested State Water Pollution Control Act has incorporated alternative provisions covering both the board and the single administrator type of agency.

States adopting water pollution control legislation recently have in some cases set up completely independent agencies, but have more frequently placed the agency within an existing State department, generally the department of health. This is a matter for determination by each individual State. Where the agency is set up within an existing State department, however, it is believed desirable to vest it with authority to act independently since an agency representing so broad a field of the State interests should not be subjected to the supervisory control of any single State department which operates in a comparatively narrower field.

Where the agency is established in an existing State department it is recommended that it be placed in the State health department. Not only is health a major public interest and an integral part of an active water pollution control program, but also the health department usually has trained personnel and facilities which may be utilized for work in connection with the water pollution control program. It will usually be true that the health department is already carrying on some of the functions which this Act vests in the new agency. Use of health department personnel and facilities therefore will avoid unnecessary duplication of functions.

Classification of Waters--Standards of Water Quality. Some agencies in the administration of water pollution control programs have classified the waters of the State according to their own use and have established standards of quality for such waters in accordance with their respective uses. Proponents of this method have urged that classification and setting of standards is an essential element of any comprehensive program and also that no enforcement action can be undertaken without determination of the use to which a particular body of water should be put and the degree of quality which the water must have in order to be suitable for such use. This approach, however, has been severely criticized by others who maintain that the process is administratively difficult and time consuming, that classifications once made are hard to change and tend to create vested interests, and that the tendency will be to reduce waters to the level of mere carriers of wastes because of the pressure of special interests.

The Suggested State Water Pollution Control Act authorizes the agency to classify waters and set up standards of quality for water falling within particular classifications but does not make it mandatory to do so. Classifications and standards once promulgated have a definite legal effect and their violation is made unlawful; conversely, discharges which comply with such classifications and standards are not pollution within the meaning of this Act. In view of the number of persons affected by classifications and standards, it is required that their adoption be preceded by a public hearing open to all residents of the areas affected, and that adequate notice thereof be given. The Act provides that in classifying waters and setting standards the agency will be guided by the principle of constantly seeking to improve water quality and upgrading streams for progressively higher uses to the maximum extent practicable.

Permits. Potentially one of the most effective techniques for control of water pollution is a permit system, under which discharges of wastes into any waters of the State are prohibited except as permitted by the agency after examination of plans, specifications and other data. Through this means the agency can either prohibit discharges altogether or condition their approval on treatment adequate to protect legitimate water uses. The Act contains broad provisions authorizing the agency to require permits for waste discharges and additions to plants which would result in increased pollution. Normally, the permit system would be restricted to new pollution or increases in existing waste discharges, but the breadth of the language employed is sufficient to enable the agency to extend the requirement to existing discharges where this is considered desirable administratively.

Enforcement. The Act affords a variety of methods for proceeding against any alleged polluter. It is made unlawful to cause any pollution of the waters of the State or to violate any order issued by the agency, including an order establishing a classification of waters or standards of water quality. Pollution of waters of the State is declared to be a public nuisance and is therefore subject to abatement in accordance with State practice for abatement of nuisances. Violation of the provisions of the Act or any order or determination by the agency or failure to perform any duty imposed by the Act is declared to be a misdemeanor. In addition, the Attorney General has the duty to bring an action for an injunction against any person violating any provision of the Act or any order of the agency. The principal method of making the program effective through compulsory process, however, is by administrative action. The agency is empowered to issue orders against alleged polluters after adequate opportunity for hearing. Such orders if not appealed to the courts become final and are enforceable in much the same way as the judgment of a court. The same administrative hearing procedure is employed in cases of revocation, denial or modification of permits.

Appeals may be taken to the courts from orders of the agency. Such appeals do not involve trial de novo but are primarily reviews of the legal propriety of the agency's decision. If the prescribed statutory procedure has been followed and the determination is supported by substantial evidence, the order of the agency will be affirmed by the court.

It is recognized that the provisions of the Act for administrative hearings and judicial review will not be appropriate in all cases. Each State will necessarily adapt them to their own administrative and judicial practice and existing statutes. The provisions of the Act, however, embody principles which are believed desirable in this type of legislation.

Administrative Powers. The Act confers on the agency the requisite administrative powers to carry out its responsibilities. Thus, the agency is empowered to hold hearings, subpoena witnesses, enforce its subpoenas, administer oaths, examine plans and specifications, require the keeping of records and the making of reports, and enter on property at reasonable times for purposes of inspection and investigation.

The Council of State Governments endorses the "Suggested State Water Pollution Control Act" and recommends it to States for favorable consideration.

10/4/50

SUGGESTED STATE WATER POLLUTION CONTROL ACT

(Title. It should conform to State requirements. The following is a suggestion; a more complete title should be used where necessary.)

"AN ACT to establish a State water pollution control agency, and to control, prevent and abate pollution of the surface and underground waters of the State."

(Be it enacted, etc.)

Section 1. Statement of Policy.[1] Whereas the pollution of the waters of this State constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life, and impairs domestic, agricultural, industrial,[2] recreational and other legitimate beneficial uses of water, and whereas the problem of water pollution in this State is closely related to the problem of water pollution in adjoining States, it is hereby declared to be the public policy of this State to conserve the waters of the State and to protect, maintain and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses; to provide that no waste be discharged into any waters of the State without first being given the degree of treatment necessary to protect the legitimate beneficial uses of such waters; to provide for the prevention, abatement and control of new or existing water pollution; and to cooperate with other agencies of the State, agencies of other States and the Federal Government in carrying out these objectives.

Section 2. Definitions. For the purposes of this Act, the following words and phrases shall have the meanings ascribed to them in this section.

(a) "Pollution" means such contamination, or other alteration of the physical, chemical or biological properties, of any waters of the State, or such discharge of any liquid, gaseous or solid substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful or detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

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[1] Where a State has committed itself to a general water resources program, a declaration to the effect that water pollution control is an integral part of such program should be added.

States in the West and Southwest may want to add a statement to the effect that water pollution control is basically a water conservation program in their States.

[2] Specific wastes which are of particular interest to an individual State may be included, such as mine wastes, etc.

(b) "Wastes" means sewage, industrial waste and all other liquid, gaseous or solid substances which may pollute or tend to pollute any waters of the State.

(c) "Sewerage system" means pipe lines or conduits, pumping stations, and force mains, and all other constructions, devices, appurtenances and facilities used for collecting or conducting wastes to a point of ultimate disposal.

(d) "Treatment works" means any plant, disposal field, lagoon, dam, pumping station, incinerator, or other works used for the purpose of treating, stabilizing or holding wastes.

(e) "Disposal system" means a system for disposing of wastes, and includes sewerage systems and treatment works.

(f) "Waters of the State" means all streams,3/ lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this State or any portion thereof.

(g) "Person" means the State, any municipality, political subdivision, institution, public or private corporation, individual, partnership, or other entity.

3/ Seaboard States should include within this definition such coastal waters as are within the jurisdiction of the State.

Section 3. Creation and Organization of Board; Meetings; Employees. There is hereby created and established[4] a State water pollution control board hereinafter referred to as the "Board" which shall be composed of ____ members as follows: The Director of the Department of Health; the Director of the Department of Agriculture; the Director of the Department of Agriculture; the Director of the Department of Conservation, Fish and Game; and two members appointed for terms of _____ years by the Governor. One of the members appointed by the Governor shall be experienced in the field of municipal government and one shall be experienced in the field of industrial activities.[5] The Board is directed to carry out the functions and duties conferred on it by this Act.

Each ex-officio member of the Board may, by official order filed in his respective department, designate a deputy in his department to perform the duties of the member making the designation. Such persons, if any, designated pursuant to this section, shall have the powers and be subject to the duties and responsibilities of the officer appointing him.[6]

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[4] The State water pollution control authority may be set up as an independent board or may be established within an existing State department. Regardless of where the Board is placed, it is important that the statutory authority flow directly to it and that it have independent powers of operation.

In cases where the Board is placed in an existing State department, it is suggested that it be placed within the State health department because of the close connection between the work of the State health department and water pollution control activities. Further, State health departments in most cases are already active in the field of water pollution control and have trained technical staffs working on pollution control problems.

The "Suggested State Water Pollution Control Act" may be adapted to the placing of water pollution control authority within the State health department by inserting the words "in the State health department" after the word "established"; virtually no other change will be necessary.

[5] This list of members of the Board is suggestive only and is not meant to be inclusive. The membership of the Board will necessarily vary from State to State. In addition to those mentioned above, some States may desire to place members on the Board for specified terms who are representatives of such fields as public affairs, recreational and resort interests, and broad water resources activities.

[6] It may be necessary in some States also to provide that: "Such designation shall be deemed temporary only and shall not affect the civil service or retirement rights of any person so designated."

No additional compensation shall be allowed any member of the Board[7] for services rendered in that capacity. Actual and necessary travel and other expenses incurred by members in the discharge of their official duties as members of the Board shall be paid out of any funds which are or may become available for the purposes of this Act.

The Board shall organize and annually select one of its members to serve as chairman and one of its members to serve as vice-chairman, shall hold at least four regular meetings each calendar year and shall keep a record of its proceedings which shall be open to the public for inspection. Special meetings may be called by the chairman, and must be called by him upon receipt of a written request therefor signed by two or more members of the Board. Written notice of the time and place of each meeting shall be delivered to the office of each member of the Board and the executive secretary. A majority of the members of the Board shall constitute a quorum.

The Board shall appoint an executive secretary[8] who shall direct and carry out all water pollution control activities vested in the Board. Such executive secretary shall be a person fully trained and experienced in the field of water pollution control and if the Board so desires, may be a present employee of the State government. The executive secretary in the interim between meetings of the Board shall have authority to perform in the name of the Board all functions and duties of the Board except the authority to adopt and promulgate standards, rules and regulations; classify streams; revoke permits; and issue or modify orders.

The Board may employ, compensate, and prescribe the powers and duties of such officers, employees, and consultants, in accordance with the laws of this State, as may be necessary to carry out the provisions of this Act. However, technical, legal or other services shall be performed, insofar as practicable, by personnel of the department of health and by other State departments, agencies, and offices.

The Board may delegate to the executive secretary, officers, employees, and consultants of the Board such functions and duties as are vested in the Board by this Act, except the authority to adopt and promulgate standards, rules and regulations; classify waters;

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[7] In States where it is customary to provide an honorarium for members of State Boards and Commissions, similar allowances should be made for those members of the State water pollution control board who are not serving in an ex-officio capacity.

[8] It may be necessary to include a statutory provision for the salary of the executive secretary, if the State statutes do not provide an overall compensation system for State officials.

revoke permits; and issue or modify orders.

(ALTERNATE SECTION 3)

Section 3. Creation and Organization of Agency and Advisory Board; Meetings, Employees. (a) There is hereby created and established[9] a State water pollution control agency[10] hereinafter referred to as the "Agency".

(b) The Governor shall appoint an administrator who shall be the head of the Agency, shall perform all functions and duties given to the Agency under this Act, and shall direct and carry out all water pollution control activities vested in the Agency.[11] Such administrator shall be a person fully trained and experienced in the field of water pollution control and if the Agency so desires may be a present employee of the State government.

(c) The Agency may employ, compensate, and prescribe the powers and duties of such officers, employees, and consultants in accordance with the laws of the State as may be necessary to carry out the provisions of this Act.

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[9] The State water pollution control authority may be set up as an independent Agency or may be established within an existing State department. Regardless of where the Agency is placed, it is important that the statutory authority flow directly to it and that it have independent powers of operation.

In cases where the Agency is placed within an existing State department, it is suggested that it be placed within the State health department because of the close connection between the work of the State health department and water pollution control activities. Further, State health departments, in most cases, are already active in the field of water pollution control and have trained technical staffs working on the problem.

The "Suggested State Water Pollution Control Act" may be adapted to the placing of water pollution control authority within the State health department by inserting the words "in the State health department" after the word "established"; virtually no other change will be necessary.

[10] It may be desirable to modify this type of Agency by making provision for a Review Board to review the final orders of the single administrator.

[11] It may be necessary to include a statutory provision for the salary of the administrator, if the State statutes do not provide an overall compensation system for State officials.

However, technical, legal or other services shall be performed, insofar as practicable, by personnel of the department of health and by other State departments, agencies, and offices.

(d) The Administrator may delegate to the executive secretary, officers, employees, and consultants of the Agency such functions and duties as are vested in the Agency by this Act, except the authority to adopt and promulgate standards, rules and regulations; classify waters; revoke permits; and issue or modify orders.

(e) There is hereby established within the Agency a State Water Pollution Control Advisory Board consisting of _____ members. Such members are to be appointed by the Governor for terms of _____ years or until successors shall be appointed or qualified,[12] and shall consist of the Administrator of the State water pollution control agency who shall be chairman, and persons experienced in the fields of public health; agriculture; conservation, fish and wildlife; political subdivisions; and industrial activities.[13] The Water Pollution Control Advisory Board shall hold at least two regular meetings each calendar year. It shall be the duty of the Board to review the policies and program of the State water pollution control agency as developed under authority of this Act and to make recommendations thereon to the Administrator of the Agency.

No compensation shall be allowed any members of the Board[14] for services rendered in that capacity; however, actual and necessary travel and other expenses incurred by members in the discharge of their official duties as members of the Agency shall be paid out of any funds which are or may become available for the purposes of this Act.

Section 4. Powers and Duties. The Board[15] shall have and may exercise the following powers and duties:

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[12] Provision should be made for overlapping terms of office for the members of the Advisory Board.

[13] This list of members of the Advisory Board is suggestive only and is not to be deemed to be inclusive. The membership of the Board will necessarily vary from State to State and may include ex-officio members.

[14] In States where it is customary to provide an honorarium for members of State Boards and Commissions, similar allowances should be made for those members of the State Water Pollution Control Advisory Board who are not serving in an ex-officio capacity.

[15] The word "Board" is used throughout subsequent sections of the Act. Where alternate section 3 is selected, the word "Board" should be changed to "Agency".

(a) To develop comprehensive programs for the prevention control and abatement of new or existing pollution of the waters of the State;

(b) To advise, consult, and cooperate with other agencies of the State, the Federal Government, other States and interstate agencies, and with affected groups, political subdivisions, and industries in furtherance of the purposes of this Act;

(c) To accept and administer loans and grants from the Federal Government and from other sources, public or private, for carrying out any of its functions;

(d) To encourage, participate in, or conduct studies, investigations, research and demonstrations relating to water pollution and causes, prevention, control, and abatement thereof as it may deem advisable and necessary for the discharge of its duties under this Act;

(e) To collect and disseminate information relating to water pollution and the prevention, control, and abatement thereof;

(f) To adopt, modify or repeal and promulgate standards of quality of the waters of the State and classify such waters according to their best uses in the interest of the public under such conditions as the Board may prescribe for the prevention, control and abatement of pollution;

(g) To adopt, modify, repeal, promulgate and enforce rules and regulations implementing or effectuating the powers and duties of the Board under this Act;

(h) To issue, modify or revoke orders (1) prohibiting or abating discharges of wastes into the waters of the State; (2) requiring the construction of new disposal systems or any parts thereof or the modification, extension or alteration of existing disposal systems or any parts thereof, or the adoption of other remedial measures to prevent, control or abate pollution; and (3) setting standards of water quality, classifying waters or evidencing any other determination by the Board under this Act;

(i) To review plans, specifications or other data relative to disposal systems or any part thereof in connection with the issuance of such permits as are required by this Act;

(j) To issue, continue in effect, revoke, modify or deny, under such conditions as it may prescribe, to prevent, control or abate pollution, permits for the discharge of wastes into the waters of the State, and for the installation, modification or operation of disposal systems or any parts thereof;

(k) To exercise all incidental powers necessary to carry out the purposes of this Act.

Section 5. Prohibitions. (a) It shall be unlawful for any person to cause pollution as defined in section 2 (a) of this Act of any waters of the State or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any waters of the State. Any such action is hereby declared to be a public nuisance.

(b) It shall be unlawful for any person to carry on any of the following activities without first securing such permit[16] from the Board, as is required by it, for the disposal of all wastes which are or may be discharged thereby into the waters of the State: (1) the construction, installation, modification or operation of any disposal system or part thereof or any extension or addition thereto; (2) the increase in volume or strength of any wastes in excess of the permissive discharges specified under any existing permit; (3) the construction, installation, or operation of any industrial or commercial establishment[17] or any extension or modification thereof or addition thereto, the operation of which would cause an increase in the discharge of wastes into the waters of the State or would otherwise alter the physical, chemical or biological properties of any waters of the State in any manner not already lawfully authorized; (4) the construction or use of any new outlet for the discharge of any wastes into the waters of the State.

The Board under such conditions as it may prescribe, may require the submission of such plans, specifications and other information as it deems relevant in connection with the issuance of such permits.

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[16] Some States may wish to validate by statute permits or approval of plans and specifications presently in effect which have been issued by competent State authorities such as the department of health.

[17] Western and Southwestern States should include the construction, installation, modification or operation of irrigation projects.

Section 6. Classification of Waters; Standards of Water Quality. (a) In order to effectuate a comprehensive program for the prevention, control and abatement of pollution of the waters of the State, the Board is authorized to group such waters into classes according to their present and future best uses for the purpose of progressively improving the quality of such waters and upgrading them from time to time by reclassifying them, to the maximum extent that is practical and in the public interest. Standards of quality for each such classification consistent with best present and future use of such waters may be adopted by the Board and from time to time modified or changed.[18]

(b) Prior to classifying waters or setting standards or modifying or repealing such classifications or standards the Board shall conduct public hearings in connection therewith. Notice of public hearing for the consideration, adoption or amendment of the classification of waters and standards of purity and quality thereof shall specify the waters concerning which a classification is sought to be made or for which standards are sought to be adopted and the time, date, and place of such hearing. Such notice shall be published at least twice in a newspaper of general circulation in the area affected and shall be mailed at least twenty days before such public hearing to the chief executive of each political subdivision of the area affected and may be mailed to such other persons as the Board has reason to believe may be affected by such classification and the setting of such standards.

(c) The adoption of standards of quality of the waters of the State and classification of such waters or any modification or change thereof shall be effectuated by an order of the Board which shall be published in a newspaper of general circulation in the area affected. In classifying waters and setting standards of water quality or making any modification or change thereof, the Board shall announce a reasonable time for persons discharging wastes into the waters of the State to comply with such classification or standards, unless such discharges create an actual or potential hazard to public health.

Any discharge in accord with such classification or standards shall not be deemed to be pollution for the purposes of this Act.

Section 7. Proceedings before Board. (a) Whenever the Board determines there are reasonable grounds to believe that there has been a violation of any of the provisions of this Act or of any order of the Board, it may give written notice to the alleged violator or violators specifying the causes of complaint. Such notice shall require that the matters complained of be corrected or that the alleged violator appear before the Board at a time and place specified in the notice and answer the charges complained of. The notice shall be delivered to the alleged violator or violators in accordance with the provisions of subsection (e) of this section not less than ____ days before the time set for the hearing.

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[18] States which adhere to the "prior acquisition doctrine" should take cognizance of the effect that classification will have on water rights established under other laws.

(b) The Board shall afford an opportunity for a fair hearing in accordance with the provisions of section 8 to the alleged violator or violators at the time and place specified in the notice or any modification thereof. On the basis of the evidence produced at the hearing the Board shall make findings of fact and conclusions of law and enter such order as in its opinion will best further the purposes of this Act and shall give written notice of such order to the alleged violator and to such other persons as shall have appeared at the hearing and made written request for notice of the order. If the hearing is held before any person other than the Board itself, such person shall transmit the record of the hearing together with recommendations for findings of fact and conclusions of law to the Board which shall thereupon enter its order on the basis of such record and recommendations. The order of the Board shall become final and binding on all parties unless appealed to the courts as provided in section 11 within ____ days after notice has been sent to the parties.

(c) Any person who is denied a permit by the Board or who has such permit revoked or modified shall be afforded an opportunity for a hearing in connection therewith upon written application within ____ days after receipt of notice from the Board of such denial, revocation or modification.

(d) Whenever the Board finds that an emergency exists requiring immediate action to protect the public health or welfare, it may without notice or hearing issue an order reciting the existence of such an emergency and requiring that such action be taken as it deems necessary to meet the emergency. Notwithstanding the provisions of subsection (b) of this section such order shall be effective immediately. Any person to whom such order is directed shall comply therewith immediately but on application to the Board shall be afforded a hearing as soon as possible. On the basis of such hearing the Board shall continue such order in effect, revoke it or modify it.

(e) Except as otherwise expressly provided, any notice, order, or other instrument issued by or under authority of the Board may be served on any person affected thereby personally or by publication, and proof of such service may be made in like manner as in case of service of a summons in a civil action, such proof to be filed in the office of the Board; or such service may be made by mailing a copy of the notice, order, or other instrument by registered mail, directed to the person affected at his last known post office address as shown by the files or records of the Board, and proof thereof may be made by the affidavit of the person who did the mailing, filed in the office of the Board.

Every certificate or affidavit of service made and filed as herein provided shall be prima facie evidence of the facts therein stated, and a certified copy thereof shall have like force and effect.[19]

Section 8. Hearings. The hearings herein provided may be conducted by the Board itself at a regular or special meeting of the Board, or the Board may designate hearing officers who shall have the power and authority to conduct such hearings in the name of the Board at any time and place. A record or summary of the proceedings of such hearings shall be taken and filed with the Board, together with findings of fact and conclusions of law made by the Board. In any such hearing a member of the Board or a hearing officer designated by it shall have the power to administer oaths, examine witnesses and issue in the name of the Board notice of the hearings or subpoenas requiring the testimony of witnesses and the production of evidence relevant to any matter involved in such hearing. Witnesses who are subpoenaed shall receive the same fees and mileage as in civil actions. In case of contumacy or refusal to obey a notice of hearing or subpoena issued under this section, the ________ court shall have jurisdiction upon application of the Board or its representative, to issue an order requiring such person to appear and testify or produce evidence as the case may require and any failure to obey such order of the court may be punished by such court as contempt thereof.

Section 9. Inspections and Investigations; Maintenance of Records. The Board or its duly authorized representative shall have the power to enter at reasonable times upon any private or public property for the purpose of inspecting and investigating conditions relating to pollution or the possible pollution of any waters of the State.

Any authorized representative of the Board may examine any records or memoranda pertaining to the operation of disposal systems. The Board may require the maintenance of records relating to the operation of disposal systems. Copies of such records must be submitted to the Board on request.

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[19] Where not otherwise covered by general provisions of State statutes applicable to all administrative agencies, consideration should be given to covering the following points in the "Suggested Act":

(1) Filing or recording the regulations and orders of the State agency with a designated official;
(2) Making such filing and recording prima facie evidence that all requirements of law have been complied with;
(3) Requiring all courts to take judicial notice of regulations and orders when filed or recorded as prescribed;
(4) Certifying copies.

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(3) Requiring all courts to take judicial notice of regulations and orders when filed or recorded as prescribed;
(4) Certifying copies.

Section 10. Penalties;[20] Injunctions. (a) Any person[21] who shall violate any of the provisions of, or who fails to perform any duty imposed by, this Act or who violates any order or determination of the Board promulgated pursuant to this Act shall be guilty of a misdemeanor[22] and in addition thereto may be enjoined from

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[20] A number of States provide by statute for penalties, additional to those outlined in section 10, for persons killing fish by polluting the waters of the State. Such a provision appears logical and desirable, since the pollution has, in effect, destroyed property of the State and the person responsible should be liable to pay damages therefor. Such provision has not been included in this "Suggested Act", however, since it is considered more appropriate for inclusion in the conservation laws of the State. If the State wishes to include it in this Act, the following language may be employed:

> "(c) Any person who violates any of the provisions of, or fails to perform any duty imposed by, this Act, or who violates an order or other determination of the Board promulgated pursuant to this Act, and causes the death of fish or other wildlife shall, in addition to the penalties provided in subsections (a) and (b) be liable to pay to the State an additional amount equal to the sum of money reasonably necessary to restock such waters or replenish such wildlife as determined by the Board after consultation with the fish and game commission. Such amount may be recovered by the Board on behalf of the State in a civil action brought in the ________ court."

[21] Where the order is directed against a municipality, the responsible municipal officials would have responsibility for taking steps to comply with it. To enable them to take the necessary action, there must be adequate statutory provision for financing such action by the municipality. Issuance of revenue bonds is a method of financing which has received increasingly broad acceptance in recent years. In those States where such issuance is contingent on a vote of the electors of the municipality, enforcement of the Act would be facilitated by a provision waiving the necessity of such a vote in the case of revenue bonds issued to finance the cost of complying with a final order abating pollution. It is believed that the requirement of such a vote is not appropriate where the legal obligation of the municipality to construct a treatment works or take other remedial action has been established under a statute.

[22] If the penalty provided for misdemeanors by general statutes is considered insufficient, the State may wish to strike out the balance of the sentence after "misdemeanor" and substitute the following:

> "and upon conviction thereof shall be punished by a fine of not more than $______ or by imprisonment for

continuing such violation. Each day upon which such violation occurs shall constitute a separate violation.

(b) It shall be the duty of the Attorney General on the request of the Board to bring an action for an injunction against any person violating the provisions of this Act, or violating any order or determination of the Board. In any action for an injunction brought pursuant to this section, any finding of the Board after hearing or due notice shall be prima facie evidence of the fact or facts found therein.

Section 11. Review.[23] (a) An appeal may be taken from any final order or other final determination of the Board, by any person who is or may be adversely affected thereby, or by the Attorney General on behalf of the State to the _______ court of the State of the area affected or to the _______ court of (seat of Government). Within 30 days after receipt of a copy of the order, or other final determination, or after service of notice thereof by registered mail, the appellant or his attorney shall serve a notice of appeal on the Agency through its (executive secretary) or (Administrator) provided that during such 30-day period the court may for good cause shown extend such time for not exceeding an additional 60 days. The notice of appeal shall refer to the action of the Board appealed from, shall specify the grounds of appeal, including both points of law and fact which are asserted or questioned by the appellant. A copy of the original notice of appeal with proof of service shall be filed by the appellant or his attorney with the clerk of the court within ten days of the service of the notice and thereupon the court shall have jurisdiction of the appeal.

(b) The appellant and the Board shall in all cases be deemed the original parties to an appeal. The State through the Attorney General or any other person affected may become a party by intervention as in a civil action upon showing cause therefor. The Attorney General shall represent the Board, if requested, upon all such appeals unless he appeals or intervenes in behalf of the State. If the Attorney General or a member of his staff is not available to represent the Board in any particular proceeding, the Board is empowered to appoint special counsel for such proceeding. No bond or deposit for costs shall be required of the State or Board upon any such appeal or upon any subsequent appeal to the Supreme Court or other court proceedings pertaining to the matter.

(c) The appeal shall be heard and determined by the court upon the issues raised by the notice of appeal and the answer thereto

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[22] (cont'd) a term of not more than one year or by both such fine and imprisonment. In addition thereto such person may be enjoined from continuing such violation."

[23] The above appeal procedure is suggestive only. In any particular State such procedures will necessarily be adapted to the existing judicial structure and practice.

according to the rules related to a trial in the nature of an appeal in equity of an administrative determination. All findings of fact by the Board are to be deemed final, unless it is shown that such findings were not supported by substantial evidence produced before the Board at the hearing. In any appeal or other proceeding involving any order, or other determination of the Board, the action of the Board shall be prima facie reasonable and valid and it shall be presumed that all requirements of the law pertaining to the taking thereof have been complied with. A copy of the proceedings before the Board shall be certified to the court in connection with each appeal.

(d) A further appeal may be taken to the Supreme Court of the State in the same manner as appeals in equity are taken.

Section 12. Conflicting Laws. This Act shall not be construed as repealing any laws of the State relating to the pollution of waters thereof or any conservation laws, but shall be held and construed as auxiliary and supplementary thereto, except to the extent that the same are in direct conflict herewith.

Section 13. Existing Rights and Remedies Preserved. It is the purpose of this Act to provide additional and cumulative remedies to prevent, abate and control the pollution of the waters of the State. Nothing herein contained shall be construed to abridge or alter rights of action or remedies in equity or under the common law or statutory law, criminal or civil, nor shall any provision of this Act, or any act done by virtue thereof, be construed as estopping the State, or any municipality or person, as riparian owners or otherwise, in the exercise of their rights in equity or under the common law or statutory law to suppress nuisances or to abate pollution.

Section 14. Severability. If any section, subsection, sentence, clause, phrase or words of this Act is for any reason held to be unconstitutional, such decree shall not affect the validity of any remaining portion of this Act.

Section 15. Short Title. This Act may be cited as the (State) Water Pollution Control Act.

NOTE: Where State law or practice requires that an appropriation authorization or an actual appropriation be made with basic legislation, such provisions should be incorporated into the "Suggested Act".

APPENDIX B

STREAM DISCHARGES DURING PERIOD OF SAMPLING

Stream	Miles from mouth		Flow c.f.s.	Mean
	Niobrara River	Tributary		
Niobrara	38		1600)	1290
			1710)	
			1140)	
			1050)	
			1080)	
			1170)	
Long Pine Creek	96	5	157)	130
			162)	
			118)	
			112)	
			103)	
			128)	
Plum Creek	109	0.2	187)	119
			129)	
			112)	
			97)	
			95)	
			93)	
Niobrara River	140		793)	748
			760)	
			700)	
			740)	
Minnechaduza Creek	146		26)	28
			34)	
			39)	
			26)	
			17)	
			25)	
Bear Creek	204		90)	66
			96)	
			72)	
			29)	
			43)	
Ponca Creek			50)	15
			15)	
			6.0)	
			4.3)	
			6.7)	
			9.0)	

APPENDIX C

SUMMARY OF INDIVIDUAL RESULTS

LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling Point	Mileage from Mouth	Date 1949	Avg. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D.	Coliforms M.P.N.	pH	Turb.	Alkal.	Cl.	Nitrogen - N p.p.m.			PO_4
					p.p.m.	% Sat.	p.p.m.	Per 100 ml		p.p.m.	p.p.m.	p.p.m.	NH_3	NO_2	NO_3	
Verdigre Creek (River)	N - 5.0 Ve. C. - 9.3	7:19 A June 9		17	8.39	86.1	1.8	23,000	8.5	240	148	0.4	<0.040	0.004	11.000	-
Water Plant intake at Verdigre	"	7:56 A June 16		21	8.37	93.3	1.4	24,000	8.3	240	154	2.6	0.315	0.023	0.055	-
	"	6:24 A June 23		19	7.86	84.1	> 7.9	4,300	8.3	180	150	1.4	-	-	-	-
	"	4:44 A June 28		19	7.32	78.3	5.8	24,000	7.9	700	134	2.6	1.850	0.001	0.060	-
Niobrara River	N - 38.8	7:36 A June 13	1,600	18	8.30	87.1	2.0	4,300	8.2	360	150	0.5	0.080	0.002	0.280	-
Bridge - 5 miles southeast of Spencer, U.S. Highway #281	"	7:43 A June 15	1,710	19	8.33	89.1	2.4	1,500	8.2	300	144	< 0.1	0.120	<0.001	0.230	-
	"	7:05 A June 17	1,140	22	7.30	82.7	3.1	2,300	8.3	220	132	< 0.1	0.070	<0.001	0.080	-
	"	7:17 A June 21	1,050	20	7.76	84.7	3.6	720	8.3	170	130	0.3	0.070	<0.001	0.050	-
	"	7:30 A June 23	1,080	22	7.26	82.3	3.5	1,500	8.3	160	124	< 0.1	0.060	<0.001	0.080	-
	"	7:14 A June 27	1,170	21	7.40	82.4	3.8	9,300	8.3	140	127	0.8	0.070	<0.001	0.170	-
Keya Paha River	N - 55.5 K.P. - 31.8	11:29 A June 13		21	8.10	90.2	3.5	2,400	8.3	210	254	< 0.1	0.120	<0.001	0.080	-
Bridge at Mills	"	2:35 P June 15		25	7.48	89.3	4.2	230	8.3	180	250	0.5	0.070	<0.001	0.080	-
	"	9:47 A June 17		24	7.60	89.1	3.4	2,400	8.3	180	251	<0.1	0.060	<0.001	0.070	-
	"	9:25 A June 21		22	8.09	91.6	2.9	2,300	8.3	120	244	0.8	0.050	<0.001	0.030	-
	"	10:00 A June 23		23	7.63	88.0	2.9	2,300	8.3	110	245	< 0.1	0.070	<0.001	0.070	-
Long Pine Creek	N - 95.5 Lo.P.C.-5.2	3:03 P June 13	157	21	7.79	86.7	4.1	93,000	8.1	600	102	0.5	0.190	0.014	1.60	-
County Bridge at Winfield	"	11:16 A June 15	162	20	8.25	90.0	2.3	23,000	8.2	230	88	0.2	0.160	<0.001	1.80	-
	"	12:46 P June 17	118	20	8.14	88.7	2.2	23,000	8.2	60	83.6	< 0.1	0.070	0.003	0.750	-
	"	12:41 P June 21	112	22	8.39	95.0	1.0	2,300	8.2	25	81.6	0.1	0.040	0.003	0.720	-
	"	12:58 P June 23	103	21	8.58	95.5	1.3	15,000	8.3	25	77.2	0.1	0.060	0.002	0.650	-
	"	11:07 A June 27	128	21	8.44	93.8	1.8	75,000	8.2	25	80.4	0.3	0.075	<0.001	0.900	-
Bone Creek	N - 95.5 Lo.P.C.-13.0	2:54 P June 14		20	6.17	67.3	3.9	43,000	7.5	25	60	0.4	0.270	-	-	-
Bridge - 1.5 miles north of Ainsworth, State Highway #7	Bo.C.- 18.4 "	3:12 P June 16		24	6.04	70.8	3.0	240,000	7.7	20	90	2.0	0.430	0.024	4.500	-
	"	2:06 P June 20		22	6.90	78.2	2.8	7,300	7.9	7	88.4	4.3	0.510	0.090	2.100	-
	"	2:03 P June 24		21	9.91	110.2	3.8	9,300	8.1	3	89.2	6.5	0.360	0.150	2.500	-
	"	2:12 P June 28		25	-	-	-	-	7.3	3	84.4	6.1	0.280	0.046	1.680	1.50
Bone Creek	N - 95.5 Lo.P.C.-13.0	3:10 P June 14		20	6.25	68.2	3.1	4,300	7.5	10	71.2	< 0.1	0.240	-	-	-
County Bridge at Ainsworth, 1 mile north of U.S. Highway #20	Bo.C. -19.8 "	3:27 P June 16		26	5.76	70.1	1.9	46,000	7.7	15	85.2	0.8	0.290	0.003	4.000	-
	"	2:21 P June 20		22	6.91	78.3	1.6	43,000	7.8	15	82.8	0.5	0.320	0.014	0.350	-
	"	2:20 P June 24		21	8.00	89.0	1.5	9,300	7.9	10	75.2	< 0.1	0.230	0.013	3.000	-
	"	2:39 P June 28		25	-	-	-	-	7.3	2	71.6	0.3	0.175	<0.001	1.000	0.67
Long Pine Creek	N - 95.5 Lo.P.C.-17.3	1:57 P June 13		17	9.11	93.6	1.6	24,000	8.0	10	84.4	< 0.1	0.110	0.003	0.700	-
1.0 mile north of Long Pine - no bridge	"	12:52 P June 15		17	9.22	94.8	1.5	43,000	8.1	15	62.8	<0.1	0.110	0.001	0.700	-
	"	1:53 P June 17		19	8.75	93.5	1.4	9,300	8.0	5	63.6	0.1	0.100	0.002	0.600	-
	"	1:44 P June 21		2[illegible]	9.00	100.1	1.2	24,000	7.9	8	64.0	0.1	0.130	0.002	0.600	-
	"	2:21 P June 23		19	8.67	92.8	2.0	110,000	8.0	10	46.0	0.2	0.190	0.002	0.900	-
	"	12:16 P June 27		19	8.19	87.5	1.7	23,000	7.6	20	59.6	< 0.1	0.160	<0.001	0.750	-

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LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling Point	Mileage from Mouth	Date 1949	Avg. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Cl. p.p.m.	Nitrogen - N p.p.m.			PO4
					p.p.m.	% Sat.							NH3	NO2	NO3	
Long Pine Creek	N - 95.5 Lo.P.C.-21.5	2:16 P June 13		18	8.41	88.3	1.1	1,500	8.0	10	68.0	<0.1	0.060	0.004	0.350	-
Bridge - 2.0 miles south of Long Pine,	"	12:09 P June 15		17	8.78	90.2	0.9	750	8.1	8	55.2	0.5	0.050	0.002	0.400	-
State Highway #55	"	1:36 P June 17		19	8.45	90.4	1.1	4,600	8.0	5	55.6	0.4	0.080	0.002	0.450	-
	"	1:25 P June 21		21	8.60	95.6	1.1	430	7.9	8	55.6	0.1	0.120	0.001	0.500	-
	"	1:58 P June 23		19	8.73	93.5	1.2	930	8.1	10	53.2	0.5	0.090	<0.001	0.400	-
	"	11:49 A June 27		19	8.72	93.4	0.9	2,300	8.1	10	53.6	0.6	0.090	<0.001	0.450	-
Niobrara River	N - 108.2	12:37 P June 13		23	7.81	90.0	2.0	4,300	8.3	160	124	0.2	0.050	0.002	0.140	-
Bridge - 13.8 miles north of Ainsworth,	"	3:56 P June 15		27	7.70	95.5	3.3	4,300	8.3	150	129	<0.1	0.060	0.004	0.160	-
State Highway #7	"	10:55 A June 17		22	7.94	89.9	3.8	4,300	8.3	180	132	0.5	0.050	<0.001	0.050	-
	"	10:41 A June 21		24	7.92	92.9	3.7	910	8.3	100	126	<0.1	0.040	<0.001	0.050	-
	"	11:08 A June 23		23	7.92	91.3	3.6	930	8.3	75	124	<0.1	0.055	<0.001	0.075	-
	"	2:03 P June 27		25	7.26	86.7	2.5	230	8.3	40	108	0.9	0.060	<0.001	0.300	-
Plum Creek	N - 108.7 Pl.C. - 0.2	12:53 P June 13	187	21	7.57	84.3	1.2	4,300	8.3	120	184	0.3	0.090	<0.001	0.750	-
Bridge - 1.0 mile west of Meadville	"	4:09 P June 15	129	24	7.42	87.1	1.4	930	8.3	45	163	<0.1	0.150	<0.001	1.60	-
	"	11:13 A June 17	112	23	7.46	86.0	1.0	2,400	8.3	45	148	<0.1	0.130	<0.001	0.550	-
	"	10:54 A June 21	97	24	7.59	89.0	0.9	2,300	8.3	50	124	<0.1	0.090	<0.001	0.710	-
	"	11:19 A June 23	95	23	7.52	86.7	0.7	2,300	8.3	40	118	<0.1	0.075	<0.001	0.700	-
	"	1:45 P June 27	93	27	7.22	89.5	0.8	3,900	8.3	25	104	<0.1	0.045	<0.001	0.650	-
Niobrara River	N - 139.6	1:36 P June 16	793	24	8.00	93.8	2.1	2,300	8.3	80	128	1.0	0.080	<0.001	0.165	-
Bridge - 9 miles east of Valentine,	"	12:25 P June 20	760	24	8.10	95.0	2.7	4,300	8.3	70	120	<0.1	0.060	<0.001	0.100	-
State Highway #7	"	12:39 P June 24	700	23	8.40	96.8	2.6	2,300	8.3	85	112	<0.1	0.120	<0.001	0.100	-
	"	12:30 P June 28	740	25	-	-	-	-	8.2	60	112	0.3	0.275	<0.001	0.080	0.30
Niobrara River	N - 146.0	5:46 P June 10	215	26	7.10	86.4	2.0	7,500	8.3	200	116	0.2	0.160	0.002	1.760	-
Bridge - [illegible] 1/2 miles northeast of	"	1:36 P June 14	881	21	8.38	93.3	1.6	1,100	8.2	85	117	0.1	0.100	-	0.350	-
Valentine, State Highway #7	"	1:00 P June 16		24	7.86	92.1	2.1	750	8.3	85	121	<0.1	0.050	<0.001	0.170	-
	"	11:52 A June 20		24	7.90	92.6	2.4	930	8.3	75	112	0.1	0.050	<0.001	0.080	-
Minnechaduza River	N - 147.0 M. - 2.4	5:26 P June 10		26	7.96	96.9	2.7	46,000	8.3	10	200	<0.1	0.190	0.010	1.600	-
Bridge at confluence of Minnechaduza	"	1:07 P June 14		21	8.91	99.1	2.3	43,000	8.3	20	214	<0.1	0.220	-	0.650	-
River and Spring Creek, 2.0 miles	"	12:33 P June 16		23	8.67	99.9	2.8	23,000	8.3	20	180	0.4	0.090	0.005	0.400	-
east and 1.0 mile north of Valentine	"	11:35 A June 20		23	9.50	109.5	3.3	9,300	8.3	10	180	<0.1	0.075	0.005	0.180	-
	"	12:02 P June 24		22	9.11	103.2	3.2	43,000	8.3	40	167	<0.1	0.210	0.018	0.480	-
	"	11:56 A June 28		23	-	-	-	-	7.9	20	159	<0.1	0.275	<0.001	0.280	0.34
Minnechaduza River	N - 147.0 M. - 4.0	5:01 P June 10		26	9.84	119.7	4.1	110,000	8.4	10	200	0.6	0.320	0.002	1.700	-
Above Diversion Dam	"	12:46 P June 14		21	7.50	83.5	2.4	75,000	8.3	20	200	<0.1	0.330	-	0.600	-
	"	12:07 P June 16		22	8.99	101.9	2.8	240,000	9.3	20	184	<0.1	0.110	0.005	0.450	-
	"	10:54 A June 20		23	8.00	92.1	5.5	93,000	8.3	15	178	<0.1	0.090	0.006	0.160	-
	"	11:42 A June 24		23	5.86	67.5	3.0	93,000	8.2	40	169	<0.1	0.240	0.012	0.450	-
	"	11:37 A June 28		23	-	-	-	-	7.3	25	150	0.3	0.350	<0.001	0.280	0.30

LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling Point	Mileage from Mouth	Date 1949	Avg. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Cl. p.p.m	Nitrogen - N p.p.m.			PO_4
					p.p.m.	% Sat.							NH_3	NO_2	NO_3	
Minnechaduza River	N - 147.0 M. - 4.5	4:39 P June 10	26	25	7.98	95.3	1.7	2,400	8.3	35	202	0.3	0.210	0.002	0.140	-
Gaging Station at Valentine	"	12:28 P June 14	34	20	8.00	87.3	1.6	2,300	8.3	45	189	0.3	0.180	-	1.000	-
	"	11:47 A June 16	39	21	7.71	85.9	2.2	2,300	8.3	50	188	0.2	0.140	0.005	0.400	-
	"	10:40 A June 20	26	22	7.62	86.4	2.4	430	8.3	40	192	< 0.1	0.240	<0.001	0.450	-
	"	11:26 A June 24	17	20	7.74	84.2	2.6	430	8.3	100	163	< 0.1	0.230	0.003	0.500	-
	"	11:26 A June 28	25	23	-	-	-	-	7.5	90	143	0.1	0.270	<0.001	0.280	0.25
Bear Creek	N - 214.4 Be.C. - 9.3	3:16 P June 10	9.0	25	7.48	89.3	1.1	930	8.3	15	88.8	0.7	0.060	<0.001	0.070	-
Staff Gage Station, access road through	"	10:32 A June 14	9.6	17	8.61	88.4	1.2	390	8.1	10	95.6	0.2	0.160	-	-	-
Gus Wukman farm, 3.0 miles southwest	"	10:03 A June 16	7.2	18	8.02	84.2	0.9	430	8.1	10	104	1.0	0.100	<0.001	0.090	-
of Eli	"	9:27 A June 20	2.9	20	7.48	81.6	0.8	2,400	8.1	20	102	0.1	0.080	<0.001	0.110	-
	"	9:40 A June 24	-	17	8.12	83.5	0.8	750	8.0	10	83.2	0.1	0.060	<0.001	0.150	-
	"	9:43 A June 28	4.3	21	-	-	-	-	7.6	9	76.8	0.1	0.175	<0.001	0.120	0.85
Niobrara River	N - 258.6	12:32 P June 10	142	24	7.25	85.0	1.6	430	8.3	55	177	1.3	0.070	0.003	0.500	-
Bridge - 11 miles south of Gordon,	"	8:48 A June 14	168	14	8.83	85.2	1.8	2,900	8.3	40	164	0.9	0.080	-	1.100	-
State Highway #27	"	8:15 A June 16	149	16	7.83	78.8	2.0	2,100	8.3	25	200	< 0.1	0.070	<0.001	0.650	-
	"	7:35 A June 20	108	17	7.50	77.0	1.2	4,300	8.3	15	192	< 0.1	0.100	<0.001	0.600	-
	"	8:17 A June 24	102	16	8.28	83.3	2.0	9,300	8.3	25	144	0.9	0.130	0.003	0.600	-
	"	7:55 A June 28	94	18	-	-	-	-	8.3	8	148	1.4	0.350	<0.001	0.200	0.20
Ponca Creek	Po.C. - 35.0	8:20 A June 13	50	17	8.45	86.7	4.7	15,000	8.3	800	222	6.9	0.150	0.003	1.100	-
1 mile east of Spencer on County	"	8:18 A June 15	15	17	8.77	90.0	1.5	4,300	8.3	330	218	7.5	<0.040	<0.001	1.000	-
Highway - no bridge	"	7:30 A June 17	9.0	21	7.85	87.3	1.2	7,500	8.3	180	233	8.8	0.050	0.003	0.800	-
	"	7:33 A June 21	6.0	18	8.35	87.6	1.4	>110,000	8.3	65	218	11	0.040	0.005	0.680	-
	"	8:02 A June 23	4.3	21	8.03	89.4	1.4	43,000	8.3	40	207	11	<0.040	0.005	0.700	-
	"	7:47 A June 27	6.7	19	7.78	83.3	1.9	93,000	8.3	40	196	10	0.060	0.004	0.900	-
Ponca Creek	P.C. - 36.2	8:44 A June 13		17	9.85	102.1	6.5	93,000	8.3	1,200	192	5.6	[illegible]	0.002	0.850	-
County Bridge - 1 mile north of Spencer	"	8:39 A June 15		17	8.55	87.8	1.2	9,100	8.3	350	214	6.3	0.050	<0.001	0.800	-